

# The Role of Lexical Morphology, In Light of Recent Developments.

5383135

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### **Abstract**

In recent years there has been a growing interest in psycholinguistic approaches to modelling morphology. Theorists working within this framework claim that the formal theory of lexical stratification is untenable in light of recent discoveries. In order to address these claims, this paper engages closely with a number of lexical stratification models, with a particular focus on Giegerich's base-driven stratal model, as well as a number of cognitive based approaches. A critical discussion of some "problematic" circumstances — which arise as a result of derivational suffixation as well as compounding — that have identified in the psycholinguistic and lexicalist literature reveals some interesting similarities between the stratal model and the cognitive approaches. To investigate these apparent similarities, this paper examines a number of theories that model the way words are accessed from the mental lexicon, and their applicability to the stratal model. Finally, key data from a number of neuro-imaging studies is brought to bear upon the stratal model. Engaging closely with this data, it became clear that the neuro-linguistic findings are not incompatible with the features of stratal models. By exploiting this data, some ideas regarding a potential synthesis between the two theoretical frameworks are tentatively put forward, and some key issues are highlighted as possible areas of interest for future research.

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# Chapter 1:

## The Development of Lexical Morphology

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### 1.0 *Introduction*

The basic premise of lexical stratification is the interaction between morphology and phonology in a series of ordered levels. Stratification encodes two separate types of affixation bases that are distinguished by their phonological behaviour, and gives a morphological foundation to this distinction. However, the new research direction proposed by Hay, Bybee, Plag, Baayen and others suggests that models of Lexical Phonology are no longer useful. Plag argues that lexical morphology is redundant because it requires recourse to ‘phonological, morphological and semantic information’ to explain affix behaviour in terms of stratal apparatus, whereas the theory of cognitive processing that he proposes as an alternative makes use of the above properties alone (2003: 173). In addition, existing stratal models are unable to draw a sharply dividing line between strata, which can be seen as another weakness of the lexical approach.

This paper aims to provide a detailed assessment of the formal stratification model and as well as the recent study of cognitive processing carried out by Hay, Bybee and the others cited above. In doing so, this paper hopes to address the question whether the findings of Hay et al, which were unavailable at the time the formal model was established, provide evidence for or against the stratification model, and indeed whether the formal stratification model can be maintained, or modified, in light of the new research. As the role of inflectional morphology is very limited in English, the focus will remain on derivational processes, specifically suffixation and compounding.

At this point it is worth mentioning the recent work that has done by Kiparsky, McMahon and Bermúdez-Otero among others, in the field of Stratal Optimality Theory, an approach which integrates level stratification and cyclicity into the theoretical framework of Prince and Smolensky’s Optimality Theory. While remaining aware of developments in this direction, an investigation into the specific claims of this approach, and a comparison with psycholinguistic models of morphology is outwith the scope of this paper.

### 1.1 *Prelude to Stratal Morphology*

In the earliest models of generative grammar, morphological variation was thought to arise solely from a combination of phonological and syntactic rules, with no specific morphological module available to the grammar. Chomsky’s 1957 *Syntactic Structures* was a proposal for a theory of transformational generative grammar (TGG). It was described as ‘combining phrase structure and grammatical

transformations' in order to formulate a 'more powerful model', as neither theory could, by itself, adequately account for a number of linguistic phenomena. Within the TGG framework, the lexicon was thought to be part of the syntax module. As such, there was no specific morphological module available to the grammar. Instead, 'lexical rules' were thought to be part of a categorical component.

Chomsky's 1965 *Aspects* provided a 'substantial revision' of the theory of grammar, because it argued for the separation of the lexicon and the rewriting rules. Idiosyncratic, or irregular, word forms were specified in the lexicon, such that rewriting rules only produced regular forms. Each form entered in the lexicon was marked with information regarding lexical category, inherent and contextual features, and sub-categorisation and selectional restrictions. Due to the substantial amount of grammatical information inherent to the lexical entries, Chomsky hypothesised that the lexicon could be organised in a way that would allow for the cross-classification of lexical items, and also enable for the identification of certain aspects of syntactic behaviour.

Chomsky's 1970 'Remarks on Nominalization' ('Remarks') sought to expand this idea. The main focus of 'Remarks' was the difference between regular nominal gerunds, which are formed by the suffixation of *-ing* to almost any verb; and derived nominalisations, which result from the idiosyncratic affixation of various suffixes. The latter process results in the derivation of suppletive or otherwise distorted forms that have the internal structure, and sometimes the morphological properties, of noun phrases; they are thus syntactically distinct from nominal gerunds. By examining the phono-syntactic characteristics of the two types of nominalisation, Chomsky shows that there is a systematic difference between the two types of nominalisations in terms of their internal structure, syntactic productivity and semantic regularity. This indicates a need to distinguish between the ways that the two forms are produced by the speaker.

Chomsky concluded that 'the transformationalist hypothesis is correct for the gerundive nominals [sic] and the lexicalist hypothesis for the derived nominals' (1970: 215). Importantly, the difference between the two types of nominals could be extrapolated to act 'as a test case for the validity of the distinction [between the lexical and transformational treatment of word formation], and ... the methodology introduced was supposed to apply, at least, to derivational processes in general' (Hoekstra et al 1974, cited in Scalise 1984: 19). Both grammatical transformations and lexical features were incorporated into the new linguistic theory set out in 'Remarks.' Another addition, the Extended Lexical Hypothesis, resulted in the conclusion that transformations cannot introduce lexical material, which in turn created the 'theoretical space for an autonomous morphological component' (Scalise 1984: 20). This proved to be an important stage in the movement towards a 'modular' hypothesis of the organisation of grammar.



A different, but equally important observation was made by Halle, in his 1970 paper 'Prolegomena to a Theory of Word Formation.' In this theory, the lexicon consisted of a list of all morphemes, which undergo word formation rules (WFRs). The distinction between affixes and bases is collapsed, as both are contained in the 'List of the Morphemes.' While the WFRs specify the combination of morphemes, they also make more use of the linguistic information stored in the lexicon and perform more abstract operations than a simple concatenation model. They are sensitive to both the category of the base and the eventual output. In fact, a WFR's application can be determined by the phonological shape of the output. In Halle's framework, the verbalising suffix *-en* only attaches to monosyllabic adjectival stems which end in an obstruent or a sonorant/obstruent cluster. However, *soften* is well-formed because a phonological rule causes the deletion of the final constant /t/, thereby creating the environment for *-en* suffixation. This entails that at different stages in the derivation, WFRs have access to the repository for stored forms and the output of the phonological component, despite the fact that both these components are sited later in the derivation. The morphological component is no longer completely linear, allowing for cyclic rule application. However, Halle's early model had a number of flaws, including unrestricted cyclic rule application, and the over-generation of WFRs. Nevertheless, it is an important development, as this is seen as one of the first models of lexical morphology.

## 1.2 Stratal Morphology

There are a number of variations on models of stratal morphology, with different theorists positing anywhere between two and four strata. These models of morphology also differ in terms of the specific processes motivating the combination of morphemes. While most theorists argue in favour of affix-specific morphological behaviour, there has been a more recent move arguing in favour of base-driven morphology. Several variant models will be discussed below.

### 1.2.1 'Topics in English Morphology' (Siegel 1974)

Siegel's 1974 dissertation, which was chiefly concerned with the division of English affixes into two discrete classes, has had a lasting influence on the development of theories of stratified morphology. The treatment of affixes in her dissertation inherits features from Chomsky and Halle's (1968) *The Sound Pattern of English* (SPE), specifically the representation of boundary markers relevant to derivational morphology. In SPE, Chomsky and Halle posited three boundary types, namely +, # and =, where the "=" marker was specifically associated with Latinate prefixes. However, Siegel counters that only two types of affix boundaries, namely "+" and "#", are necessary to account for the morphological behaviour of suffixes as well as prefixes, such that the prefixes designated with SPE's "=" boundary marker are actually "+" boundary affixes. On the basis of these two different boundary types, she argues that there are in fact two different classes of affixes; Class I comprises "+-boundary" affixes, while Class II consists of "#-boundary affixes". Each class of affix is associated with specific types of morphophonological

behaviour: Class I affixes ‘influence the placement of primary stress’, while Class II affixes are ‘stress neutral’ (Siegel 1974: 112). In addition, as per SPE, Class I affixes are marked with the etymological feature [+Latinate]. On this basis, she observes Class I and Class II affixation are ordered extrinsically, such that Class I affixation precedes stress assignment, which in turn is followed by Class II affixation. While Class II cannot change stress assignment, the affixes belonging to this class are sensitive to existing stress patterns in the base. Therefore, although adjective forming *-ful* normally attaches to end stressed nouns, Siegel argues that the well-formedness of *mournful* and *forgetful* prove that in this case the stress information present in the base overrides the constraints of grammatical category to allow suffixation.

Class I affixes are also associated with the phonological distortion of the base. For example, Class I noun forming *-y* ‘changes preceding /t/ to [s] (*democrat* ~ *democracy* and *president* ~ *presidency*)’, whereas the ‘neutral (i.e. Class II) adjective-forming *-y* does not affect final *t* (in *chocolaty*, *bratty* etc)’ (SPE: 86, cited in Siegel 1974: 113). In addition, Siegel notes that ‘Class II affixes attach to words and not to stems’, which are bound morphemes that are not associated with a specific syntactic category. Instead, stems, underived words and Class I prefixes and suffixes form the input to Class I affixation. Ordering Class I affixation before Class II affixation means that it is the output of Class I affixation that forms the input to Class II derivation, which proves to be the reason why only words form the input to Class II affixation. A notable exception to this are the Class II affixes *-some* and *-less*, which are in fact attested with bound morphemes, specifically in the word forms *gruesome*, *winsome*, *fulsome*, *hapless* and *reckless* (149). However, Siegel notes that these words form a small class of listed exceptions to the affix stacking generalisation. The observations regarding affixal behaviour leads to Siegel’s generalisation of the stacking-up of Class I and II affixes, namely that ‘Class II affixes may appear outside Class I affixes, but Class I affixes may not appear outside Class II affixes’ (163, 182). While ultimately Siegel’s Level Ordering Hypothesis has come to be largely disproved, it must be noted that the observations made in her paper did play an important role in the formation of models of lexical phonology and morphology.

### 1.2.2 ‘Lexical Phonology and Morphology’ (Kiparsky 1982)

In his 1982 paper ‘Lexical Morphology and Phonology’ Kiparsky wrote that the mental lexicon is structured such that all derivational and inflectional processes can be organised into a series of ordered levels, or strata. On each level is stored a specific ‘set of phonological rules for which (the level) defines the domain of application’ (3). Furthermore, the structure of the lexicon determines the order in which word formation processes can apply, such that the output of one level is not available for phonological rules associated with an earlier stratum. This level ordering is derived from Siegel’s generalisation regarding the stacking up of Class I and II affixes; Kiparsky illustrates this with specific reference to the negative prefixes, Class I *in-* and Class II *non-*. The phonological characteristics of the two classes of affixes differ such that Class I affixes are base distorting, and the phonological rules associated with Class I affixes does predict that the assimilation of phonological features. In this case, the affixation of *in-* to

*legible* results in the form *illegible*, whereas in the affixation of *non-* there is no assimilation. In Siegel's theory, it is argued that this is because the strong “#” boundary of Class II affixes will prevent the assimilation of phonological characteristics. In model currently under discussion, the ‘correlation between boundary strength and affix order’ is inherent in the level ordering. In Siegel's theory, phonological rules apply after Class I affixation, while Kiparsky's theory has both phonological rules and morphological operations integrated on the same level. In this case, the assimilation rule is assigned to Level 1, along with the prefix *in-*, while *non-* belongs to Level 3. Kiparsky demonstrates that Siegel's observations regarding affix stacking can be incorporated into his theory without the need for additional framework, in this case the boundary symbols.

Kiparsky's model of lexical stratification in English is a three strata model, formalised in Fig. 1.1 below:

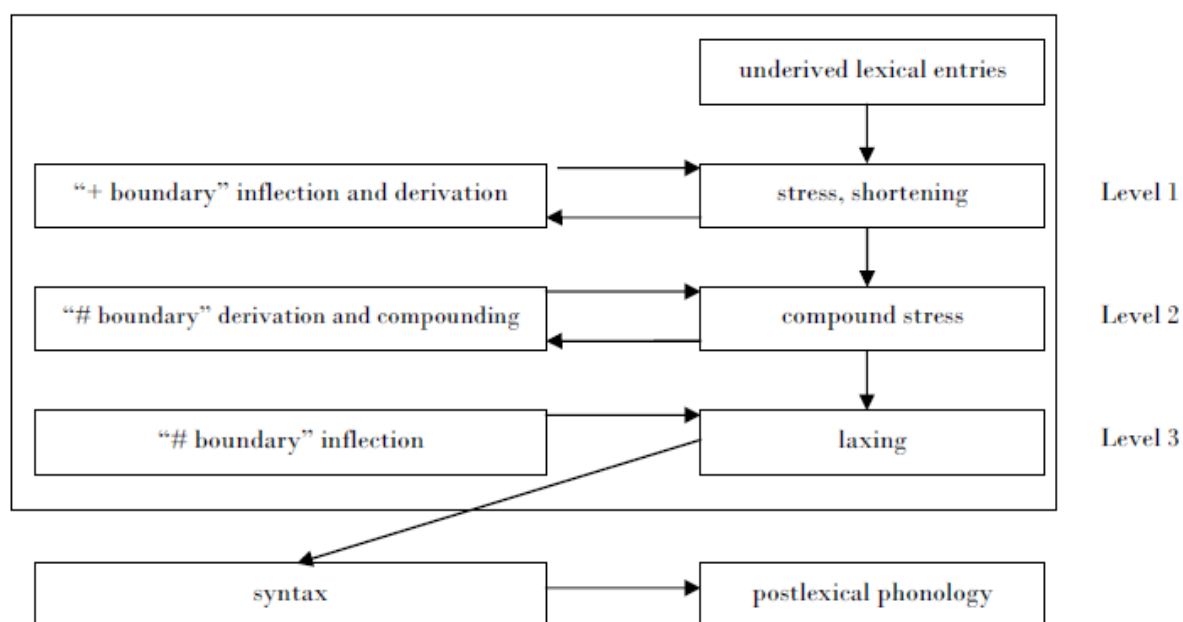


Fig. 1.1

(from Kiparsky 1982: 5)

Stored on Kiparsky's level 1 are the “+– boundary affixes”, such as the Class I ‘derivational suffixes *-al*, *-ous*, *-ity*, *-th* among others’ as well as irregular inflection, and other affixes associated with morphophonological changes resulting in base distortion’ (1982: 5). Class II affixes, such as *-ness*, *-hood*, *-er* and *-ism* among others, are located on Level 2. Kiparsky also claims that the processes of compound word formation and “#-boundary derivation” are located on the second level. As such, the suffixes such as *-ness*, *-hood*, *-er* and *-ism*, among others, which are marked for #-boundary derivation, are

stored here. The third, and final, level is the domain for the application of regular inflection, such as plural *–s* and past tense *–ed*.

As implied by the directionality of the arrows in Fig. 1.1, the levels are cyclic, such that a derived word form generated on a particular level can be subject to further derivational processes that are stored on the same level. Kiparsky identifies that ‘rules above the word level’, that is, rules applying post-lexically, are not subject to the Strict Cyclicity Condition (SCC). The SCC states that lexical rule applications cannot change structure in environments that were not derived in their cycle, where a derived environment is one created by the concatenation of two morphemes, or by the prior application of rule from the same cycle. Instead, cyclic rule application is restricted to the lexicon, such that the phonology and morphology work in tandem so that ‘the cyclic rules of level  $n$  may be relevant to the morphology of  $m$ , where  $n \leq m$ ’ (1982: 33). In addition, Kiparsky’s model adopts the Bracket Erasure Convention, which stipulates that at the end of a level, word-internal morphological brackets are erased, so that the output of each level is a well-formed lexical item. This erasure of morphological brackets entails that morphological rules located on a particular level have no access to the internal morphological structure of words derived on preceding levels.

An important feature of Kiparsky’s model is the interaction between affixation and compounding. The evidence for this can be seen in the ‘appearance of level 1 plurals inside ordinary noun compounds’, which shows that inflectional affixation can interact with compounding (9). The model derives irregular inflection on Level 1 and regular inflection on Level 3; this ‘predicts that irregular inflection should be available to derivational processes (i.e. compounding) at level 2’, whereas forms containing Level 3 regular inflection, in this case plural *–s*, should not be available (9). For example, the compound *mice-infested*, which contains the Level 1, irregular plural form *mice*, is well-formed, whereas the compound *\*rats-infested* is ill-formed as it contains the Level 3, regular plural form *rats*. This further explains why exocentric compounds carry Level 3 inflection, even if ‘their second members are by themselves inflected at level 1’; when compounding is carried out at Level 2, these forms exclusively have singular morphology. As such, past tense can only be assigned at Level 3, such that the endocentric compound *sabertooth* has the regular plural form *sabertooths* (10).

In addition, evidence for the interaction between derivational affixation and compounding is presented in Kiparsky’s analysis of deverbal derivation, and in particular synthetic compounds, for instance *typesetter*, *frontrunner*, and *watchmaker*, and also exocentric synthetic compounds, such as *three-legged*, *moon-faced* and *fair-minded*. If compounds were not able to incorporate derived forms, the above examples have to be treated as simple noun + noun compounding, an analysis which would fail to account for a number of idiosyncratic characteristics that are associated with synthetic compounds. These arguments support the separation of the lexicon into discrete levels, and shows that such a separation is not motivated purely by Siegel’s Affix Ordering Generalisation.

### 1.2.2.1 Blocking and the Elsewhere Condition

A second crucial theory in Kiparsky's paper is his explanation of the blocking effect. The blocking effect is an automatic process which is inherent in the grammar, and the Elsewhere Condition is the mechanism responsible for the operation of blocking. The Elsewhere Condition helps to preserve morphological structure because it blocks cyclic rules from applying in non-derived environments. The real importance of this is that it acts as an explicit statement of the role of morphology in phonology. The Elsewhere Condition is formulated below:

Rules A, B in the same component apply disjunctively to a form  $\phi$  if and only if:

- (i) The structural description of A (the special rule) properly includes the structural description of B (the general rule).
- (ii) The result of applying A to  $\phi$  is distinct from the result of applying B to  $\phi$ .

In that case, A is applied first, and if it takes effect, then B is not applied.

(Kiparsky 1982: 8)

Essentially, the application of a more specific, 'special', rule will pre-empt a regular, 'general', rule, thus 'blocking' it from operating (8).

There are two main types of blocking, homonymy blocking and synonymy blocking. The former is not seen as crucial because it operates to prevent the formation of a derived form that is phonologically identical to an existing word form in order to prevent ambiguity, although this argument 'fails to explain why language tolerates innumerable ambiguities ... but should avoid this particular one' (Plag 2003: 64). Therefore, synonymy blocking, which itself can be divided into two, more specific instances of blocking, is more significant in terms of morphological behaviour. Type-blocking and token-blocking are both types of synonymy blocking, though they operate with differing degrees of specificity. Type-blocking is concerned with the interaction of rivalrous morphological process, where the output of one rule blocks the output of another rule or rules which occur later in the derivation. One such example of this is the Class II noun forming affix *-ness* which is blocked from regular application by a number of Class I affixes including *-ity* and *-th*. Token-blocking, on the other hand, refers to the blocking of potential regular forms by synonymous forms which are listed in the lexicon. Evidence from child language acquisition further shows that if a listed form is learned after a regularised form is derived by rule application, the idiosyncratic stored form will supersede the regular form. However, instances of blocking failure may occur due to the over-generalisation of a productive rule, where no idiosyncratic form is available to force token-blocking.

The existence of doublets, such as *cooker* / *cook* or *driller* / *drill* appears to be another instance of blocking failure, but it is a question of synonymy. In the case of *cooker* / *cook*, noun forming *-er* forms an



the stem final tensing rule does not apply before Class II affixes with a ‘strong’ # boundary, for example *–ness*. To account for this distribution, Halle and Mohanan stipulate that the domain of application of the stem-final tensing rule is the stratum following that on which Class II affixes are attached, namely, their Stratum 3. The distinction between the phonologic realisation of forms like *happiness* and *city ball* clearly supports the reasoning for Class II affixation and compounding occur on separate strata. However, this cannot account for the fact that Stratum 2 affixation and compounding appear to ‘provide inputs to each other’, which motivated Kiparsky’s argument that the two morphological processes occur on the same stratum (Halle and Mohanan 1985: 64).

In order to resolve this issue, while maintaining the stratal distinction between the two processes, Halle and Mohanan propose what they call a morphological Loop. They claim that allowing for a recursion to an earlier level ‘allows a stratum distinction for the purposes of phonology’ which provides an account for the different surface realisations of the vowel in *happiness* and *city ball*, such that the former is lax, [hæpɪnəs] and the latter, tense [sɪti hɔɪ], ‘without imposing a corresponding distinction in morphological distribution’ (64). Therefore in their formulation, words containing Class II derivational suffixes and compound words share morphological features.

The authors specify that the loop is restricted to a correspondence between Stratum 2 and Stratum 3 only. However, the fact that the loop is an explicit stipulation, and in addition is motivated solely by the stem final tensing rule, proves to be a major weakness of this model. This theoretical assumption undercuts the significance of level ordering, making it possible to argue in favour of a similar correspondence between any two given strata, as there is no independent motivation that governs the inter-stratal interaction typified by the “Loop”.

#### 1.2.4 *The Theory of Lexical Phonology* (Mohanani 1986)

Mohanani’s 1986 monograph is in many respects very similar to the earlier collaboration with Halle. However, Mohanani extends the theory to apply to linguistic phenomena occurring in Malayalam, thereby providing cross-linguistic support for his version of stratal morphology. Mohanani’s four strata model also incorporates the notion of the Loop.

As with the earlier model, Mohanani’s Level 4 is the domain of application of sonorant resyllabification, so that a ‘syllabic consonant becomes non-syllabic when followed by a vowel-initial derivational suffix’ (McMahon 2000: 63). Sonorant resyllabification does not occur in compound formation, which in light of Halle and Mohanani’s separation of affixation and compounding, implies that the phonological rule applies on Level 2. However, the same consonants can resyllabify in front of vowel-initial inflectional suffixes, giving rise to the doublets tri-syllabic [twɪŋklɪŋ] and di-syllabic [twɪŋkɪlɪŋ]. This proves problematic; as rules cannot apply across non-adjacent strata, Mohanani instead introduces a

second resyllabification rule in Stratum 4. Kiparsky examines the same phenomena and concludes instead that ‘*binder#ing* and *center#ing* are trisyllabic to exactly the same extent as a noun-forming derivational *–ing* and as the present participle suffix’ (1982: 134–5, quoted in McMahon 2000: 63–4). The different approaches adopted by the theorists arise from the bracketing conventions that Kiparsky adopts. Where Halle and Mohanan assume that ‘all morphemes — roots, words and affixes alike — are identically bracketed as [X]’, Kiparsky suggests that only roots and words are represented as [X]. Prefixes and suffixes are bracketed as ‘[Y]’ and ‘[Z]’ respectively. As such, the phonological differences between compounds and suffixes, which motivated Halle and Mohanan to posit two separate strata can instead be explained by the ‘presence or absence of an initial bracket “[ ]”’ (Geigerich 1999: 12). In addition, McMahon points out that the interaction of ‘[c]ompounding and Class II derivation’ and, under specific conditions ‘compounding and regular inflection’ suggests that ‘there is no reason to posit three distinct strata for the three word formation processes’ (2000: 60). Both McMahon and Geigerich go on to propose two-stratum models of morphology; the latter model will be discussed in detail in the following section.

### 1.2.5 *Base-Driven Stratal Morphology: Lexical Strata in English* (Geigerich 1999)

The models of Lexical Phonology discussed in above in §1.2.2 – 1.2.4 differ in terms of the number of strata they comprise, as well as the morphophonological processes that are associated with each stratum. However, the models have in common one characteristic; in each model, the strata are defined in terms of the affixes which are diacritically marked, with either “+” or “#” boundary, as attaching on it. This defining characteristic is, unfortunately, one of the most commonly cited weaknesses of lexical stratification models. The main problem with this is the overwhelming evidence which points to the ‘dual-membership’ of affixes, that is affixes which ‘display morphological and phonological behaviour that is consistent with both strata’ (Geigerich 1999: 3). Geigerich argues that most stratal theories treat dual-membership affixes as exceptional or idiosyncratic behaviour, but that this approach is unsatisfactory in light of the number of suffixes which ‘*may plausibly be assigned on both strata*’ (28, emphasis HG). He proposes 18<sup>2</sup> suffixes for dual-strata membership noting that while this analysis is ‘more permissive’ than that of other theorists, he notes that it too is ‘probably incomplete’ (27).

Motivated in part by this, Geigerich proposes a new approach, in which he formulates a theory of base-driven lexical stratification. In doing so, he argues against the efficacy of Siegel’s Level Ordering Hypothesis, proposing instead that the [+Latinate] constraint is of more interest, and that it ‘makes the [Level Ordering Hypothesis] redundant in many individual cases’ (1999: 24). The oft-cited form \**homelessness* is ill-formed not because Class I affixes cannot attach outside Class II affixes, but because [+Latinate] *–ity* is unavailable for attachment with either morphologically simple or complex bases which do not share this feature. His base-driven model of English is composed of two strata, which are

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<sup>2</sup> Assuming that cases like *–ery* / *–ry*, *–ible* / *–able* and so forth are allomorphs of the same suffix.



differentiated in terms of the bases associated with each stratum. His argument is supported by cross-linguistic evidence as a base-driven model of German morphology is also set out. In the base-driven stratification model of English, bases on Stratum 1 are either bound or free Roots, which are morphemes that do not appear to belong to any syntactic category. The category Root applies to all Stratum 1 forms, irrespective of their morphological complexity. Rules apply cyclically, and each cycle there is an “exit stage” at which point a Root, whether is it morphologically complex or not, can exit the stratum and become a Word. This transition stage, referred to as Root-to-Word conversion, is formalised below:

$$[ \ ]_r \rightarrow [[ \ ]_r]_L^3 \quad (1999: 76)$$

It is during this process that lexical categories are assigned to the roots. After this point, Stratum 1 operations can no longer apply to the derived form, and it is now available for Stratum 2 operations. This Root-to-Word conversion process cannot be said to conclusively belong to either stratum, and could quite easily belong to either. As such, Giegerich argues that ‘[i]t follows that any two contiguous strata in English ... are partially-overlapping domains by virtue of the fact that their morphological base categories constitute a natural class’ (98). The idea of overlapping strata is one that we will return to in Chapters 5 and 6.

Bases associated with Stratum 2 are derived free forms, or “Words”, which, having undergone the Root-to-Word conversion, are marked as belonging to a specific lexical category. Compared to the Stratum 2 forms, those occurring on Stratum 1 are less productive and less semantically regular. This irregular morphological behaviour could be attributed to their status as listed forms. In addition, affixation on Stratum 1 is associated with base distorting morphophonological processes, such as stress shifting and phonological rules including Trisyllabic Shortening and Spirantisation, resulting in semantic opacity while Stratum 2 affixation generally does not affect the base (Giegerich 1999: 17, 21).

Giegerich argues that affixation rules of earlier affix-driven models can be stated in the following format:

$$\text{Insert A in the environment } [Y \text{ \_\_\_ } Z]_L^4 \quad (1999: 69)$$

However, in the base-driven model, Stratum 1 forms are characteristically unspecified for lexical category. As such, Stratum 1 affixation is ‘not governed by rules as we know them’ (72). Instead Stratum 1 acts as a repository, where listed forms contain information about the morphological operations that they could potentially undergo. Affixes are only subject to the selectional restrictions that are associated with the

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<sup>3</sup> In the statement above L stands for the categories Noun, Verb and Adjective.

<sup>4</sup> Where [Y\_Z] stands for any extra details of the sub-categorisation frame that restricts affixation, and L is the lexical category specification of the base.

base or affix to which they are immediately adjacent. Stratum 2, on the other hand, is the site for the operation of regular affixation rules.

While it is true that the insight that bases, and not affixes, are the driving force behind morphological operations can, as we have discussed above, ‘overcome some inadequacies of earlier [affix-driven] stratal models’, this model is not without criticism (Plag and Baayen 2009: 3). The base-driven stratal model is problematic because the Root/Word distinction is not sharply articulated: the Root-to-Word conversion, while useful in explaining the differences in behaviour characterising Stratum 1 and Stratum 2 affixation, is nevertheless a stipulation. Instead, ‘the availability of (Root-to-Word conversion) for any given root is subject to listing’ and cannot be determined from the morphemic structure of the roots themselves (Giegerich 1999: 108, 110). As Plag writes, this entails that ‘the same form (is assigned) the status of root at level 1 and the status of a word of level 2 without independent justification’ (2003: 173). Nevertheless, it can be seen that the two stratum base-drive is conceptually superior to the affix-driven models that preceded it.

### 1.3 *Summary*

In this chapter, we have discussed a number of models of lexical stratification, starting with a brief look at the developments in a transformational approach which ultimately resulted in the evolution of stratified models. Models of affix-based stratal morphology, ranging from Kiparsky’s LPM to Halle and Mohanan’s four strata model, have been described in terms of the morphological and phonological behaviour associated with the individual stratum. Giegerich’s base-driven stratification model has also been introduced. Commonly cited weaknesses of the various models have also been identified. In addition, a number of concepts which proved invaluable to the evolution of Lexical Phonology, such as Siegel’s affix stacking generalisation, and the integration of the theory of blocking into stratal models have been touched upon. As such in the following chapters the base-driven model will be adopted as the default model of lexical stratification, unless stated otherwise.

In the following chapter, we will turn to an assessment of the claims of a number of cognitive-processing based models of morphology.

# Chapter 2:

## Psycholinguistics and Morphology

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### 2.0 *Introduction*

In the previous chapter we discussed a number of theories which all assume that words or morphemes are listed in the mental lexicon alongside morphophonological processes. In addition to stored forms, the theorists argue in favour of stratal apparatus. In this chapter, we turn to an assessment of several psycholinguistic models which share the theoretical assumption that this additional stratal framework is unnecessary and complicates the grammar unnecessarily. Instead, the theorists behind the cognitive-processing based approaches argue that phonological and morphological behaviour falls out naturally from the aggregation of relationships between items stored in the lexicon. These claims will be investigated in this chapter. In this chapter we also will directly compare these with some of the central claims of the stratal model.

### 2.1 *Usage-based Model* (Bybee 1985, 1988, 2001)

In Bybee's connectionist model of the lexicon, each lexical item has a large number and type of lexical connections to other lexical items. The internal structure of each lexical word is defined as the pairing of a set of semantic features with a set of phonological features. Morphological relationships arise when lexical items, or parts of lexical items, overlap in terms of the orthographic, phonological and semantic properties of lexical items. Word-frequency effects are also a significant factor in the establishment of morphological relations, as each time they are used 'high-frequency items grow strong and therefore are easier to access' (2001: 28). These connections form the basis of morphological relations, because when 'semantic and phonological connections coincide exactly, morphological identity can be established.' (Bybee 1988: 127) As such, Bybee predicts that with the exception of forms with a very high frequency, 'the degree of phonological connection reflects the degree of semantic connection' (139). The network connections between lexical words are represented by connecting nodes that run from the features of one word to those of a related word. The extent to which lexical items are similar is encoded in the strength, or "weight", of the connections formed between related items. Sets of nodes running between two features overlap to form word families.

Given that internal word structure is represented by lexical connections, Bybee argues that the segmentation of words into meaningful, recurring units — that is, morphemes — is unnecessary. Instead she suggests that parts of words themselves can be identified as recurring units, as there is evidence that

‘speakers can handle words that do not yield to discrete segmentation’ (1985: 128). This concept may therefore account for the occurrence of cranberry morphs, “formatives” such as *-ceive*, and *-cept* and sub-morphemic units such as phonaesthemes, which are sets of words with a weak semantic relationship and strong phonological connections in terms of their initial cluster. These phenomena cannot be adequately defined in terms of traditional morpheme based approaches. This further entails that affixes have no existence or representation independent of the words to which they attach, with the possible exception of highly productive affixes such as *-ing*, *-ed* and plural *-s*. As these affixes have a high frequency, it is therefore plausible that they have developed a permanent, independent representation in the lexicon.

Nodes connecting two lexical items may accumulate to form lexical connections of varying strengths. This allows for the establishment of a gradient morphological relationship between lexical items. For example, Bybee explains that forms with a high frequency form more distant, and therefore weaker, lexical connections with their base forms. This is because they are used more often, and recognised more readily, than low frequency words. As such, they are less dependent on their related base words. High frequency forms are also more likely to diverge semantically and phonological from their bases, and are more likely to form independent representations. Word frequency has strong correlations with lexical strength; words with a high lexical strength occur more frequently. Every time a speaker processes a word, it strengthens the representation of the lexical item, thus increasing the word’s lexical strength, and to a certain extent that of its word family.

Bybee further states that the usage-based model does not need an external framework, including that of morphological rules. Instead, there are ‘highly reinforced organizational patterns in the lexicon’ or schemas, which contain strongly represented features (2001: 27). These schemas are not stipulated categorically, but are instead probabilistic; even the most regular morphological patterns are thought to be favoured over other schema only because of the number and types of items to which they are already related.

## 2.2 *Selectional Restrictions Constraining Morphological Behaviour* (Fabb 1988; Plag 1996, 1999)

In this section, we will examine two different approaches to the way selectional restrictions affect affix ordering.

### 2.2.1 ‘English Suffixation is constrained only by Selectional Restrictions’ (Fabb 1988)

Fabb’s 1988 paper was intended as a rejection of the stratification of affixes, and specifically takes issue with Siegel’s generalisations regarding affix ordering. Although Fabb’s discussion of selectional restrictions was not set out in a psycholinguistic framework, it is a robust argument against the efficacy of level ordering as a constraint on affix behaviour.

The distinction between Class I and II affixes predicts that certain combinations of affixes immediately ruled out. However, as mentioned in §1.2.1, it is clear that Siegel's affix stacking generalisation is not problem-free. Fabb cites in particular several specific affix pairs, including *-abil-ity*, *-ist-ic* and *-ment-al*, which appear to violate level ordering constraints. Fabb's theory was motivated by a large scale empirical study of the combinatory behaviour of 43 suffixes which attach to free forms. Results from the study showed that syntactic-category restrictions, when combined with the affix ordering generalisation, predicted that there were a possible 459 suffix combinations. However, Fabb finds that of the possible combinations, only 50 are attested in English, and thus is led to conclude that the 'level-ordering of suffixes achieves relatively little in predicting which suffix pairs exist and which do not' (1988: 530). Instead, Fabb proposes a model of suffixation in which the only constraints are affix-driven restrictions on potential bases. The 43 suffixes under investigation can be divided into four sets, distinguished by the type of base that they appear to select for. The suffix types are 'suffixes (which) never attach to an already-suffixed word', those which 'attach outside only one other particular suffix', some which 'attach to all the suffixes' to which they are predicted to attach, and finally suffixes which attach outside 'some, but not all' predicted bases (532).

Fabb argues that the set of suffixes which do not attach outside other suffixes is a major argument against the effectiveness of level ordering. This particular selectional restriction is derived from Fabb's assumption that 'all internal brackets are visible to all derivational suffixes', as suffixes in this set appear to exclusively select for bases with no internal brackets (533). However, this directly contradicts Kiparsky's Bracket Erasure Convention, which was incorporated into stratal models discussed in Chapter 1. In addition, Fabb contends that this selectional restriction can predict the stacking of affixes belonging to the same affix class. This is illustrated with reference to Class I *-ify*; the inability to attach outside another suffix explains why *-ify* will not attach to Class II *-able*, as in *\*derivable-ify*, as well as Class I *-al*, or *-ive* (533).

Fabb finds that the second, smaller set of suffixes is unusual because, unlike other suffixes which select only for a base word, these affixes appear to be able to select a specific suffix as well. Furthermore, he argues that in each individual case, the 'suffix seems to have a particular affinity for another suffix', which entails that there are specific selectional restrictions influencing affix ordering. Level ordering, however, is predicated on 'affinities between sets of suffixes' (535). Selectional restrictions therefore, appear to be more accurate in predicting the combinatory behaviour of affixes.

Ultimately, however, Fabb's proposal extends only as far as limiting the framework of level ordering to the phonological component, such that all affixation would have to occur before phonology. In order to fully account for phonological rules, such as the English Stress Rule, which are sensitive to morphological complexity, Fabb suggests that a subset of affixes should be marked with a feature that would make them possible inputs to the phonological rules in question.

## 2.2.2 'Selectional Restrictions in English Suffixation Revisited' Plag (1996, 1999)

In his 1996 review of 'English Suffixation is constrained only by Selectional Restrictions', Plag engages closely with Fabb's proposals, and takes issue with some of the theoretical assumptions made by the latter. Plag notes that Fabb's approach to selectional restrictions is, like many of the models of stratal morphology discussed in the previous chapter, largely affix-driven, such that the application of phonological and morphological processes is triggered by affix behaviour. In addition, Fabb's proposal has a number of stacking restrictions 'assigned to stipulated idiosyncrasies' of individual suffixes, instead of applying more generally to groups of affixes (1996: 770).

Through a close examination of each of the 43 suffixes identified by Fabb, Plag argues instead that affix behaviour can be explained through a combination of 'constraints on usage', 'specific phonological, morphological, semantic and syntactic requirements' and the 'general psycholinguistic mechanism' of blocking (1999: 68). Importantly, suffixation is base-driven, so that in addition to suffixes selecting a specific kind of base, 'bases ... may select a certain kind of affix' as well (173).

### 2.2.2.1 'Suffixes which never attach to an already suffixed word'

As this is the largest of Fabb's groups of suffixes Plag begins his review by breaking down the group of 28 into four smaller sets. The fact that this set readily lends itself to further subdivision already suggests that Fabb's proposal that sensitivity to internal structure is sufficient to fully explain the behaviour of this set of suffixes. As such, Plag extends the proposal by dividing the suffixes in terms of syntactic category. The size of this set of affixes precludes a complete assessment of the affixes at this point. Instead, Plag's analysis of the affix set will be illustrated with reference to the abstract-noun-forming deverbal suffixes *-age*, *-al*, *-ance*, *-ment* and *-y*. Plag argues that the apparent failure of these affixes to attach to morphological complexes can be explained instead by selectional restrictions exerted by the base form. Suffixes *-ance* and *-al* for example, only attach to endstressed verbal bases, while the affixation of *-age* and deverbal *-y* is 'entirely lexically governed' (778). Finally Plag turns to the combination of verbal *-en* and *-ment*. An specific analysis of the generalisations regarding *-ment* affixation, leads to the conclusion that the *-enment* combination is possible, but 'subject to independent systematic restrictions imposed on *-ment*', restrictions which account for 'both the existence and the scarcity of *-enment* derivatives' (782).

The other 23 suffixes are divided in to the categories 'abstract-noun-forming', 'person-noun-forming', 'relational-adjective-forming' and 'verb-forming' (776, 787). The detailed analysis of these subsets leads Plag to conclude that there are 'numerous counterexamples' of suffixes attaching to

complex forms, which ‘weaken Fabb’s claims’ and that ‘base-driven selectional restrictions and general morphological constraints’ are both conceptually and empirically superior.

#### 2.2.2.2 ‘Suffixes which attach outside one other suffix’

Fabb’s second set of affixes comprises noun and adjective-forming *-ary*, denominal *-er*, *-ic*, *-(at)ory* and deadjectival *-y*. Plag’s review of the six affixes concludes that ‘with the exception of *-ic*, all of them attach to at least two other suffixes’ (789). For example, noun forming *-ary* is attested with both *-ate* and *-ment*, *contra* Fabb’s observation that *-ary* only attaches outside *-ion*. In addition, Plag argues that the constraints preventing *-ic* from attaching outside more than one suffix may be more advantageously restated as a base-driven selectional restriction. The assumption that *-ist* selects for *-ic*, and not vice versa, accounts for the fact that the combinations *\*-ist-al*, *\*-ist-ive* and *\*-ist-ent* are ill-formed.

#### 2.2.2.3 ‘Freely attaching suffixes’

Fabb identifies three suffixes, *-able*, deverbal *-er* and deadjectival *-ness*, as well as deadjectival *-en*, as being ‘subject to no selectional restrictions other than those involving part of speech’ (1988: 535). However, as Plag points out, ‘none of these suffixes is one hundred percent productive’, even over bases belonging to the appropriate syntactic category (1996: 790). This implies that there are other selectional restrictions at work, preventing the affixes in question from applying freely. Specifically, the affixes *-er* and *-ness* are prevented from applying regularly by type blocking exerted by the rivalrous suffixes *-ant* and *-ity* respectively.

In addition, the assignment of *-en* to this category is contentious; the suffix attaches exclusively to monosyllabic bases, leading Fabb to conclude that it is ‘constrained ... by two selectional restrictions’ instead of being ‘freely attaching’ (1988: 535). However, Plag demonstrates that *-en* attaches to adjectives as well as nouns, specifically only nouns ending in *-th*. The restriction that bases suffixed in *-th* will select *-en* as a suffix is more specific and complex than a simple categorial restriction stating that *-en* selects for a nominal base.

#### 2.2.2.4 ‘A problematic group of suffixes’

Fabb’s ‘problematic’ suffixes are denominal *-al*, nominalising *-ion* and *-ity* and the deadjectival suffixes *-ism*, *-ist* and *-ize*. While they are attested in combination with more than one specific affix, the behaviour of these affixes is not entirely unconstrained. Plag contends that this is a problem only in that they cannot be adequately accounted for in the framework set out by Fabb, and given the selectional restrictions, these suffixes can actually be seen to attach freely. Plag shows that the [+Linate] etymological constraint, as well as some individual base-driven restrictions can accurately explain the distribution of the suffixes *-al* and *-ity*. In the latter case, the suffix attaches to bases marked [+Linate],

except where such suffixation is blocked by the rivalrous processes. The affixes *-ism* and *-ist* also attach freely, as long as the resulting complex denotes a specific entity. Finally, though *-ize* can attach outside a large number of adjectival bases, both simple and complex, suffixation is restricted by pragmatic constraints and blocked by the existence of synonymous forms.

Plag's analysis of the four affix sets shows that affix behaviour falls out from a number of base-driven selectional restrictions, and not the affix-based restrictions proposed by Fabb. The base-driven approach is said to be 'conceptually superior' as it facilitates the prediction of both impossible and possible affix combinations (1996: 777). In addition, this is a theoretically efficient proposal because the processes that constrain suffixation can be used to account not only for the combinatory properties of affixes but for other phenomena in derivational morphology as well. Ultimately, Plag concludes that 'what has been analysed as would-be stratal behaviour falls out from the phonological, morphological and semantic properties of the affix', rendering the stipulation of stratal apparatus redundant (Hay and Plag 2004: 569).

### 2.3 'Complexity Based Ordering' (Hay 2002, 2003, 2005)

Hay appears to endorse a model of the lexicon in which 'lexical representation consists of remembered exemplars, complete with phonetic detail' (Warren, Hay and Thomas 2007: 92). In addition, Hay posits a pre-lexical processor which enables speakers to access stored forms. In Hay's account, determining the organisation of affixes relies on the ease with which complex words can be separated, or "decomposed", into their constituent morphemes. In §1.2.1, it was seen that the separation of affixes into Class I and Class II was, in part, motivated by the phonological characteristics of the resulting morphological complex. The strong "#" boundary of Class II affixes is thought to prevent the assimilation of phonological characteristics. Similarly, in Hay's theory, the boundary strength of a complex word is a function of the complex's decomposability. The decomposability of a morphologically complex form is determined by the combination of phonemes created by the concatenation of morphemes as well as a number of word frequency effects. The only constraints on affix ordering are those derived from restrictions on cognitive processing.

Like Bybee (§2.1ff.) Hay also recognises the possibility that morphological complexity can be thought of as graded, such that there is no longer a categorical distinction between complex words and monomorphemic forms. Although this is untenable under formal theories of stratal morphology, Hay cites evidence from behavioural experiments to support her claim. This evidence will be assessed in §2.3.1 – §2.3.3 below. In Hay and Baayen (2005), the authors write that speakers 'can assess which member of a pair of complex words' — for example *settlement* and *government* — 'is more complex', such that the former is reported to be 'more affixed' than *government* (2005: 343). Gradience in morphological structure also



affects the order in which affixes combine. For Hay, the gradient nature of morphology calls into question the effectiveness of standard morphological theories.

### 2.3.1 *Phonotactics*

Hay cites a range of experimental data which demonstrates that language specific phonotactics have a large role to play in segmenting and processing continuous streams of speech, and posits that sensitivity to phonotactics naturally extends to the processing of morphological complexes as well. In order to examine the relationship between decomposability and phonotactics, Hay provides data from an experiment involving nonsense words, which were modelled on pairs of suffixed forms such as *pipeful* and *boniful* which differ in terms of the phonotactics at the morpheme juncture. The ‘junctural phonotactics’ refers to the ‘probability of the sequence of sounds spanning the juncture between its parts’ (Hay and Baayen 2005: 345). At the morpheme boundary, the former has a consonant cluster /pf/ that does not occur in monomorphemic English words. However, the latter morpheme boundary has the cluster /lf/, which is fully attested morpheme internally. Based on the responses elicited from the subjects of the experiment, Hay draws the conclusion that complex words with higher probability or ‘fully legal phonotactics’ across the morpheme boundary, are more likely to be intuitively judged as morphologically simple, while words with illegal or less probable, boundary phonotactics are likely to be seen as morphologically complex (Hay 2003: 39). Another correlation between phonotactics and morphological complexity is that ‘words containing less support for their affixedness’ and are less likely to be decomposed, ‘are associated with more phonetic reduction at the morphological boundary’ (Hay and Baayen 2005: 346).

Further to this, Hay predicts that ‘consonant-initial suffixes ... should tend to be more separable than vowel-initial suffixes because they tend to enter into more illegal phonotactic combinations.’ This in turn results in ‘increased levels of parsing’ (2002: 155). Consonant-initial suffixes should therefore be represented by a large number of morphological complexes which are likely to be decomposed. This in turn entails that suffixes beginning with a consonant are more likely to be recognised as a separate morpheme, even in cases where affixation does not result in the type of phonotactic violations which would make decomposition mandatory. These results appear to support Hay’s argument that phonotactics influence morpheme decomposability, and by extension, parsability.

### 2.3.2 *Lexical Frequency*

Lexical frequency also has a key role to play in speech processing. Hay posits a Fast Phonological Preprocessor which occurs prior to lexical processing. The preprocessor segments a speech stream by ‘positing boundaries that are unlikely to occur word internally’ allowing for faster access to any ‘lexical entries that are well aligned with those boundaries’ (2002: 528). The speed with which forms are

processed is also dependent on lexical frequency; the relationship between lexical frequency and lexical access will be addressed in greater length in the following chapter.

Hay suggests that relative frequency, rather than absolute or surface frequency, is an important indicator of the decomposability of a complex form. Relative frequency is defined as the ‘ratio of the frequency of the derived form to the frequency of the base form’ and measures how ‘frequent the derivative is with respect to the base’ (Plag 2003: 176). However, relative frequency is not independent of absolute frequency; it is more likely that a derived form with a high absolute frequency has come to be more frequently used than its base form, as compared to a derived form with a low absolute frequency. Lexical complexes with a high relative frequency are more likely to develop an independent representation in the lexicon, and therefore are unlikely to be decomposed when encountered in speech.

There is also evidence to show that there is a correlation between the phonetic implementation of a complex form and its relative frequency. This can be demonstrated with regards to the realisation of the phoneme /t/ in the words *swiftly* and *softly* (from Hay 2003: 123 – 5). Both complexes have approximately the same absolute frequency. However, *soft* is more frequent than *softly*, and *swiftly* more frequent than *swift*, which entails that *swiftly* has a higher relative frequency. The results of the experiment show that *swiftly* displays more /t/-deletion than *softly*. The consonant cluster /ftl/ is not attested in monomorphemic forms; the illegal junctural phonotactics is indicative of morphological complexity, and is a trigger for decomposition. If, however, the consonant /t/ is deleted or phonetically reduced, as in the complex form *swiftly*, the word would be realised with the simplified cluster /fl/, which is attested morpheme internally. The phonetic reduction effectively removes the phonological cues which would otherwise trigger morphological separation.

Hay goes on to argue that the strong correlation between relative frequency and the absolute frequency of a derived form suggests the possibility that the ‘previously observed effects of the frequency of the derived form may in fact be artifactual’ (Hay 2001: 1060).

### 2.3.3 Productivity

Morphological productivity can be defined as ‘the creative capacity of language users to produce and understand an indefinitely large number of sentences’ (Schultink, quoted in Plag 1999: 2). Productivity can be quantified either through a ‘dictionary-based measure’, where the ‘number of neologisms with a given affix in a certain period of time ... is taken as a direct reflection of the productivity of that affix’ or by statistical, corpus based measures which are calculated with reference to the number of tokens of a morphological category which appear in a corpus, the number of different types of words containing the given affix which appear in the corpus, and the number of neologisms, ‘hapax legomena’ of a specific affix (Plag 1999: 5). Plag suggests that productivity is scalar, such that

affixes can vary in productivity with respect to specific bases. Affixes are always constrained with respect to possible bases, due to a number of phonological, syntactic and semantic conditions.

There is an inverse relationship between productivity and decomposition, such that the more frequent an affix is, the less productive it is. Productive affixes, therefore, are characterised by a large number of low frequency word forms and a large number of hapax legomena. As low frequency words are usually processed via decomposition, the constituent morphemes are well represented in the lexicon. Maintaining a strong representation of the affix as a distinct morpheme entails that it is readily available for affixation to other bases.

These factors in combination influence the decomposability of a complex form. In the next section we turn to how this affects the combination of different affixes.

### 2.3.4 *Affix Ordering Revisited*

To recap, Siegel's Level Ordering Hypothesis states that 'Class II affixes may appear outside Class I affixes, but Class I affixes may not appear outside Class II affixes' (1974: 163, 182). As discussed in the previous chapter, this has been instrumental in the development of a number of theories of stratal morphology. However, there are a number of criticisms that have been made regarding this generalisation. One commonly cited weakness of the hypothesis is that it does not offer any restrictions with regards to the concatenation of affixes belonging to the same affix class. Plag shows that while *-ize* never attaches outside *-(n)ous*, in spite of the fact that both are Class I affixes, as it stands the AOG predicts that *\*sensuousize* is a well-formed output of Class I affixation (1996: 771). In addition, as we have seen above in §2.2.1, Selkirk's affix stacking generalisation cannot adequately account for suffix combinations which are ruled out to prevent level ordering violations, and yet are attested in English.

Instead, Plag's system of base-driven selectional restrictions in combination with syntactic or semantic conditions, discussed in greater detail above in § 2.2.2, can more effectively account for attested morphological behaviour that could not be understood in terms of level ordering. Even the difference between Class I and II affixes can be expressed in terms of Plag's selectional restrictions; while the Level Ordering Hypothesis stipulates that forms like *\*homelessness* (home#less+ity) are ill-formed because Class II *-less* cannot appear inside Class I *-ity*, the proposed system can express more detailed reasons as to why such forms are illicit.

### 2.3.5 Affix Hierarchy

#### 2.3.5.1 Comparison with Stratal Models

Through a close analysis of the affixes divided between Siegel's affix classes, Hay makes a number of observations regarding the behaviour of the affixes. Class I affixes are mostly vowel-initial, whereas those belonging to Class II are largely, but not exclusively, consonant-initial. As seen above in §2.3.1, the phonotactics occurring at junctural boundaries has a significant impact on affix behaviour. Therefore, as a whole Class I affixes are less decomposable. In addition, with regards to word frequency effects, Hay demonstrates that lexical items containing Class I affixes tend to have a higher relative frequency than those containing Class II affixes. The high relative frequency explains why usually idiosyncratic forms are maintained in the lexicon instead of being regularised. Furthermore, Class II affixes as a whole tend to be regular, and therefore are more productive than the irregular Class I affixes. Hay contends that the stacking restrictions which motivated Siegel's Affix Ordering Generalisation are in fact predicted by parsing generalisations. As such, a parsing account can easily account for attested affixal behaviour in terms of cognitive processing, without the need for the external framework of lexical stratification.

#### 2.3.5.2 Hay's Affix Ordering Hierarchy

The account of affix ordering that Hay proposes inherits from Burzio's 'Structure Transparency Principle' (STP), which states that '(a) structure with a degree of compositionality  $n$  may not contain a structure with a degree of compositionality greater than  $n$ ' (Burzio 1994: 354, quoted in Hay 2003: 180). While Burzio's STP was originally postulated as an explanation as to why affixes marked as [+Germanic] cannot attach outside [+Latinate] affixes, Hay suggests instead that this principle is far more powerful, and so proposes extending the STP such that it applies to the parsing process. According to Hay, it is not the internal structure of the base itself which proves to be the deciding factor in affixation. Instead, affixation is dependent on 'how much structure that the affix itself creates' (2002: 528). Similar to Fabb's analysis of suffixal behaviour, this account is predicated on the assumption that affixes are sensitive to internal morphological structure. In terms of processing, the crucial insight gained here is that '(a)n affix which can be easily parsed out should not occur inside an affix which can' (528). Affixes are ordered in a hierarchy based on boundary strength, with affixes that can be more easily parsed out arranged at the far end of the spectrum. This arrangement mirrors the distance of the affix from the base. Plag notes that the hierarchy reflects the fact that some affixes 'create words that are less morphologically complex than the words derived with other kinds of suffixes' which is also inherent in the distinction between "+ boundary" and "# boundary" affixes (2002: 290). However, the ordering hierarchy is conceptually superior, as it also captures the insight that morphological structure itself is gradient, such that even forms containing the same affix can be decomposed to a different extent (cf. *government* and *settlement*). These

morphologically related words as a set can form a ‘distribution of varying juncture strengths’ (Hay 2002: 530).

Hay further claims that the affix hierarchy predicts that ‘any suffix below a given suffix on the hierarchy can precede that given suffix, but not follow it, and any suffix above a given suffix on the hierarchy can follow that given suffix but not precede it’ (2004: 572). Given a hierarchy A-B-C-Z-Y-Z, possible affix combinations are ‘BASE-A-B, BASE-X-A-C, BASE-Y-Z-A’ while the combinations ‘\*BASE-A-Z, \*BASE-Y-A-Z, \*BASE-X-A-Y’ are ruled out (572 – 3).

In the next section, the competing claims of Plag and Hay will be compared.

## 2.4 ‘What Constrains Possible Suffix Combinations?’ (Hay and Plag 2004)

In their 2004 paper, the two authors conducted a study on the combinatory behaviour of a set of 15 affixes in order to test their competing hypotheses about suffix stacking. Based on these 15, it was predicted that there were a potential 210 two-suffix combinations. Using a variety of corpora, the authors found that a total of 36 suffix combinations were attested in English. They note that only two of the suffixes under investigation belong to Stratum 1, which, under the constraints of level ordering would ‘rule out 26 combinations [and] 184 possible combinations of which only 36 are attested’ (576). This finding reinforces their argument that affix-driven stratal morphology alone cannot fully account for factors influencing affixation. The authors were further able to show that the data can be arranged in linear hierarchy, shown in Table 2.1 below. Suffix-combinations which occur in at least one attested form are denoted with a ‘yes’, while the blank cells denote combinations that are not attested.

	<i>th</i>	<i>en</i>	<i>er</i>	<i>ling</i>	<i>ee</i>	<i>ess</i>	<i>ly</i>	<i>dom</i>	<i>hood</i>	<i>ship</i>	<i>ish</i>	<i>less</i>	<i>ful (a)</i>	<i>ness</i>	<i>ful (n)</i>
<i>th</i>	–	yes										yes	yes		
<i>en</i>		–	yes		yes										
<i>er</i>			–	yes		yes	yes	yes	yes	yes	yes	yes			yes
<i>ling</i>				–					yes	yes		yes			
<i>ee</i>					–	yes			yes	yes					
<i>ess</i>						–	yes	yes	yes	yes		yes			
<i>ly</i>							–		yes		yes			yes	
<i>dom</i>								–				yes			yes
<i>hood</i>									–			yes			
<i>ship</i>										–		yes	yes		
<i>ish</i>											–			yes	
<i>less</i>												–		yes	
<i>ful (adj)</i>													–	yes	
<i>ness</i>														–	
<i>ful (n)</i>															–

Table 2.1

(Hay and Plag 2004: 579)

The clear diagonal that can be identified is proof that ‘there is no combination attested in which an outer suffix occurs inside an inner suffix’ (578). Although the authors note that the relative hierarchical ranks of some suffixes ‘cannot be determined with respect to one another’ in terms of the data collected in this study, they contend that ‘a strict hierarchical organisation nonetheless holds’ (578). The authors use measures of a word’s decomposability, namely parsing ratios and productivity measures, as calculated in Hay and Baayen (2002) to examine the relationship between the affix hierarchy demonstrated in Table 1 and boundary strength. They conducted a statistical analysis of suffixes’ type and token parsing ratios, productivity as well as their rank in an affix hierarchy as determined from the combinatory data. The results show that all the measures, bar that of productivity, strongly support the authors’ argument that the affix hierarchy accurately captures facts about affix ordering. They conclude that ‘affixes in the hierarchy are organised in approximate order of increasing boundary strength’, which strongly supports Hay’s Complexity Based Ordering (Hay and Plag 2004: 584).

To investigate Plag’s claim that selectional restrictions alone can successfully account for the 36 attested suffix combinations, the authors set out to identify the specific morphological, phonological, syntactic and categorical restrictions that influence the morphological behaviour of the 15 suffixes being studied. Their findings are reproduced in Table 2.2 below.

Suffix	Examples	Derived category	Base category	Semantic restriction on base	Semantic category of derivative	Phonological restriction on base
-dom	<i>freedom stardom</i>	N	N/(ADJ)	?	‘status, realm, collectivity’	?
-ee	<i>employee</i>	N	V/N	?	sentient being (non-agent)	–
-en	<i>deepen</i>	V	ADJ/N	?	change-of-state verb	– monosyllable – obstruent-final
-er	<i>baker Londoner</i>	N	V/N	?	person/instrument/etc.	–
-ess	<i>princess</i>	N	N	{male?} person/animal	female person/animal	–
-ful	<i>careful</i>	ADJ	N	abstract noun	qualitative adjective	–
-ful	<i>cupful</i>	N	N	concrete noun	partitive noun	–
-hood	<i>childhood falsehood</i>	N	N/(ADJ)	person noun	‘state of being X’	–
-ish	<i>Jewish schoolboyish greenish fortyish</i>	ADJ/Num	N/ADJ/Num	N = person noun	similative	?
-less	<i>careless</i>	ADJ	N	?	‘without X’	–
-ling	<i>duckling</i>	N	N	animate noun	young animal, (young) human being	?
-ly	<i>fatherly deadly</i>	ADJ	N/(ADJ)	N = person and time nouns	similative	?
-ness	<i>kindness</i>	N	ADJ/(any)	?	quality noun	–
-ship	<i>friendship</i>	N	N	person noun	status, collectivity	–
-th	<i>depth growth</i>	N	ADJ/V	?	quality noun	– monosyllable

Table 2.2

(Hay and Plag 2004: 587)

The authors find that ‘the vast majority of combinations’ can be ruled out by employing the suffix-particular selectional restrictions. As a result, ‘almost the same hierarchy as [that described in Table 2.1] emerges on the basis of predictions based on the grammatical properties of the suffixes’ (587). While

this seems to support Plag's hypothesis, there is a crucial difference between the two sets of results. Hay's claims about Complexity Based Ordering are derived from facts about cognitive processing. Suffixes are ranked in terms of the ease with which they can be decomposed. However, as Hay and Plag point out, though the results from the investigation of the selectional restrictions hypothesis also fall into a hierarchy, this could be a 'pure accident' (588). Instead of disproving Hay's arguments, these results provide more evidence in support of the CBO.

At the same time, selectional restrictions can provide finer details about the suffix combinations that are predicted by the CBO. While combinations above the diagonal line (see Table 1) are predicted to be potential combinations, not all of them are attested. Selectional restrictions can explain why these potential combinations are then prevented from occurring. As Hay and Plag conclude, 'both selectional restrictions and processing constraints are instrumental in determining suffix ordering', and both their hypotheses are empirically superior to the affix ordering generalisations made in affix-driven models of stratal morphology (590).

## 2.5 *Summary*

In this chapter we have seen a number of cognitive approaches to morphology, with a specific focus on the mechanisms that influence the concatenation of affixes. Morphophonological generalisations arise when items that are listed in the mental lexicon form connections with other items which share common features. As such, Bybee, Plag and Hay argue against lexical stratal models on the grounds that stratal apparatus is unnecessary and psychologically unrealistic, as linguistic phenomena can be explained in terms of the features inherent to cognitive-processing based approaches. As we have seen, Hay's analysis of the Class I and II affixes shows that affix stacking can be more accurately predicted by factors such as phonotactics, productivity and word-frequency effects. Similarly, Plag's base-driven selectional restrictions can explain phenomena such as blocking in terms of word-frequency effects, instead of simply stipulating it, as in lexical stratification models. The experimental data from Hay and Plag (2009) also seems to suggest that combining the two approaches increases the explanatory power of both. Ultimately, theorists working from a psycholinguistic approach conclude that lexical stratification models of morphology are untenable. At this point it must be noted that the majority of the criticism is directed at affix-driven models of stratal morphology. In Chapter 4 we will examine the arguments of Hay, Plag and Bybee in comparison with Giegerich's base-driven approach to lexical stratification.

In the next chapter, we will assess a number of theories that model the ways in which lexical items are retrieved from the mental lexicon, and what this means for both stratal models and the cognitive approach.

# Chapter 3:

## Lexical Access and Models of Morphology

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### 3.0 *Introduction*

Studying the ways in which speakers access complex words from the mental lexicon can help to provide an independent justification for theoretical morphological models. The mental lexicon comprises a list of stored lexical entries. The lexical entries themselves are split into two parts, one related to form and the other related to meaning and use. The latter is also known as the lemma. The 'form' includes both phonological and orthographic representation, against which spoken or written stimuli are compared, as well as morphological information. The lemma on the other hand includes syntactic and semantic information. Models of lexical access are arranged along a continuum, ranging from theories that argue only for whole word access to theories which instead argue for a wholly decomposed account of morphological access. Whole word access entails that all words encountered in speech or language are stored in the mental lexicon in their entirety, even those morphologically complex words which are regular and fully semantically transparent. A decompositional, or parsing, account of lexical access however, involves all complex words being fully broken down into constituent stem and affix morphemes and the online linguistic computation of the inherent semantic and syntactic properties of the parts. In addition, there are a number of theorists who claim that there are aspects of language production that cannot be wholly accounted for by either of these extreme models, and instead argue in favour of mixed or dual-route models that incorporate both the methods of processing. The different models of lexical access are motivated by a variety of factors, including cross-linguistic variables and other psycholinguistic factors.

### 3.1 *Mechanisms of Lexical Access*

The psychological mechanisms that enable lexical access can be formalised in a variety of different ways, with theories ranging from models that resemble computational networks to those which are modelled on analogical sets. These models also differ in terms of the specific ways in which words are retrieved, either through a feed-forward serial search of all the lexical entries stored in the central lexicon or through the activation of a search mechanism along associated networks, or clusters, of concepts (Taft 1991: 2–8). The latter is a more realistic mechanism, given the sheer length of time it would take to search



through the entire lexicon for each word that is encountered. One such model of spreading activation is the Interactive Activation Model (McClelland and Rumelhart 1981; Rumelhart and McClelland 1982).

The Interactive Activation Model allows for the parallel processing of a visual input over a set of interacting levels, which include the visual feature level, the letter level and the word level among others. The levels are in communication through a ‘spreading activation mechanism in which (neural) activation at one level spreads to neighbouring levels’; the activation can either be excitatory or inhibitory (McClelland and Rumelhart 1981: 426). Each unit found at the processing levels is associated with a node, such that on the letter level each letter of the alphabet has its own node. Upon the presentation of a string of letters, specific letter level nodes are activated, and others are inhibited. Letter nodes which are activated send ‘excitatory connections’ to the word level nodes with which they are consistent and ‘inhibit word level nodes they are not consistent with’ (433). Activated word level nodes may in turn send excitatory feedback down to the letter level, strengthening the activation of nodes at this level. If no input is presented to the perceptual processing system, all nodes are assumed to decay to a resting activation level which is determined by how frequently a node is activated over the long term. As such, highly frequent nodes are thought to have a resting activation level which is higher than those for less frequent nodes. Activating a word node can also result in an increase in the resting activation levels of words which share semantic or morphophonological connections.

### 3.2 *Factors Influencing Lexical Access*

Two constraints that greatly influence the models of lexical access are the storage and processing constraints. The economy of storage is predicated on the concept that the ‘lexicon should be minimally redundant’, which implies that storing morphemes and the rules for deriving complex forms is more efficient than listing whole words as well as their components, especially in the case of semantically transparent forms which can easily be segmented (Plag 2003: 48). This is an argument in favour of a parsing account, as the meaning of complex words arising from ‘the combination of stem and affix ... can be computed from the meaning of the stem and the affix’ (Frauenfelder and Schreuder 1991: 166). Listing both morphemes and whole words in the lexicon contravenes the idea of minimal redundancy and also increases the speaker’s memory load. This in turn negatively affects the “look up time”, which refers to the time taken to search for and access a particular lexical item, thereby limiting the efficiency of the system.

Conversely, the economy of processing constraint holds that it is more efficient to access a whole word than to go through the parsing process, as lexical retrieval places fewer processing demands on the speaker compared to online computation. Morphological parsing may be complicated by a number of factors, including parsing failure because of the presence of homophonic strings, or pseudo-stems and affixes in the language. Furthermore, factors such as polysemy, semantic drift and semantic opacity

further complicate the parsing process; in such cases, even if speakers are able to segment complex forms into their constituent morphemes, the meaning of the word still cannot be derived from the lexical semantics of the morphemes.

While the economies of storage and processing are useful factors, it is important to note that they are not absolute, and as such, other factors must be considered. For instance, the true storage capacity of the brain is not a known quantity, therefore it cannot be stated equivocally that the need to minimise the quantity of stored forms will necessarily preclude the storage of regular complex forms. At the same time, Cutler (1983) argues that there ‘is no unequivocal empirical evidence demonstrating that morphologically complex words are more difficult to process’ than simplexes, which throws doubt upon the usefulness of the processing constraint (Frauenfelder and Schreuder 1991: 167). Instead, it becomes apparent that a balance must be struck between the two factors in order to achieve maximal linguistic efficiency. This idea is elaborated upon below in §3.3.3.1, in the discussion of experimental data from Plag and Baayen (2009).

Word-frequency is another important factor that motivates models of lexical access. Frequency influences the speed of lexical access routes, and therefore is vastly useful in the formalization of dual-route models. It is more likely that ‘morphological rules (and parsing)’, not direct access to whole word forms, ‘are involved in the production and perception’ of low frequency complex forms, because low frequency forms are less likely to leave strong memory traces in the lexicon (Baayen 1992: 181). In contrast, high frequency forms are more likely to be accessed whole, which may account for the ‘tendency for morphological irregularity to be restricted to the highest frequency forms of a language’ (Bybee 1995: 235); low frequency irregular forms, however, are likely candidates to undergo regularisation.

Furthermore, Hay argues that relative frequency — the frequency of the derived word form relative to that of its base — is also an important factor in lexical access. Semantically transparent, regularly formed complexes may develop independent whole-word access representations, thus bypassing the more logical parsing route so long as the surface frequency of the complex word is higher than the frequency of its constituent morphemes (2003: 71). Hay therefore draws a direct correspondence between relative frequency and the decomposability of a word form. Her claim is that complexes with a high relative frequency are those which are more likely to be accessed via the whole word access route, which in turn raises the resting activation level of the whole word; this is a virtuous cycle that ‘reinforces (the word’s) status as an independent form’ and increases the likelihood that the whole word access route will be favoured in the future (5). This also helps to explain why the low frequency forms discussed above are less likely to be accessed via the whole word route. It must be noted that relative frequency is not the sole factor influencing a word’s activation level: Schreuder and Baayen note that a word’s ‘activation level ... is a function of the frequency of its activator’ as well as ‘the amount of feedback it receives’ from forms on located neighbouring processing levels with which it shares excitatory connections (1995: 152).

### 3.3 *Models of Lexical Access*

#### 3.3.1 *Whole Word Access Models*

Butterworth's (1983) Full Listing Hypothesis (FLH) is a direct access model which claims that all word forms, including inflectional and derivational complexes, are acquired through exposure to a corpus of words and are listed in the mental lexicon without any rules being similarly listed. Although each word has a distinct entry in the lexicon, related complexes are 'linked as SATELLITES forming part of a constellation whose nucleus is a simple un-affixed bound root or word.' (Katamba 1994: 188, emphasis author's own) There is a second variant of the FLH, which holds that complex words are listed 'complete with... morphological analysis' (230). The most obvious problems with direct access models is that they are 'by definition incapable of dealing directly with novel forms, which of course cannot be listed', as well as a similar inability to deal with the failure to retrieve a low frequency form (Frauenfelder and Schreuder 1991: 169). Butterworth therefore posits a 'fall-back procedure' of rule-governed parsing, such that rules may be memorised or induced by comparison with similar already learned forms in order to cope with inaccessible forms (1983: 263). The implication here is that the FLH model is not completely effective.

Furthermore, it is arguable that the FLH cannot easily provide a theory of lexical access which is applicable cross-linguistically. For example, Turkish, an agglutinative language with relatively transparent and segmentable affixes, relies more heavily on morphological concatenation for word formation purposes than English. As such, it is probable that in Turkish morphology the decomposition route is favoured over the whole word access route. (Katamba 1994: 231–2; Booij 2007: 243) If the FLH was to hold, there would be great storage demands placed on the speakers of Turkish.

#### 3.3.2 *Decomposed Access Models*

Within the generative tradition, especially the work of Chomsky and Halle, the basic assumption was that all word forms were generated from an underlying representation with a series of ordered rules that described the phonological and morphological changes that mediated between the surface realisation and the underlying representation. This was held to be true except in the case of 'idiosyncratic items' which were related to the base forms semantically and therefore 'were not predictable by general rule' from the same underlying representation (1968: 12). However, this caveat does not account for the fact that 'the meanings of derived words often cannot be derived from their constituent parts' (Bybee 1985: 113). As discussed above, there are a number of factors that result in semantic opacity, resulting in the failure of the full parsing model.

Taft and Forster (1975) argue that a morphological analysis is always conducted prior to lexical access, and that affixed words are recognized via access to a representation of the stem which is stored in the mental lexicon. These stored representations are considered to be shared by all morphological

derivatives of the stem. Data from lexical decision experiments show that the frequency of the stem is positively correlated with the time it takes a participant to recognise the word, which substantiates the claim that word recognition is facilitated by the stem (Taft and Forster 1975; Taft 1979). Taft and Forster's prefix stripping model is predicated on the basis that decomposing complex words into their constituent stem and suffix morphemes is economical in terms of storage. However, the main criticism levelled at the prefix stripping model, one which the authors themselves acknowledge as a limitation of the theory, is the processing cost associated with wrongly submitting a morphologically simple word to the parsing process. This may be especially relevant for languages such as Dutch and English, which comprise a large number of pseudo-affixed forms 'which would necessarily complicate the parsing process' (McQueen and Cutler 1998: 407). The additional computation involved in the erroneous parsing may well negate the benefits of economical storage.

### 3.3.3 *Dual-route Models*

An overview of the two diametrically opposed positions has demonstrated that by itself neither model will be able to provide a full account of lexical access. Data from lexical status experiments show that test subjects have greater difficulty rejecting non-words which comprise morphemes that exist in the language, than when reacting to words which contain pseudo-roots or affixes, or those which do not appear to contain any morphemes at all (Taft and Forster 1975; Caramazza et al 1988). The differences in reaction times to the different types of non-words cannot be explained without assuming that 'word structure is parsed at some stage of the lexical access process' (Chialant and Caramazza 1995: 68). However, experiments by Bybee and Slobin (1982), which dealt with the elicited production of the past tense forms of English verbs show that, where respondents failed to produce the correct past tense form for (ir)regular verbs, they either regularized the forms or overwhelmingly produced the 'Past Tense of a verb with a *close semantic relation* to the stimulus verb', which points to the idea that 'generating an irregular Past Tense form in English is a lexical retrieval task', assuming that lexical items are stored alongside semantic information (Bybee 1985: 113, emphasis in original).

Furthermore, there is neurological evidence in support of the idea of a dual-route model of lexical access. Booij cites a study conducted by Jaeger et al (1996) which used positron emission topography (PET) to assess the specific regions of the brain involved in processing the past tense forms of regular and irregular English verbs. The study 'found that regular forms are processed faster than irregular forms', and that processing irregular forms 'activated significantly larger areas of the brain' compared to regular forms (Booij 2007: 244). A similar study conducted by Beretta et al (2003) provides functional magnetic resonance imaging (fMRI) data as evidence of a 'division of labour for regular and irregular verbs' (Baayen 2007: 15). A study conducted by Vannest, Polk and Lewis (2005) shows that this is the case for derivational morphology as well. The authors provide fMRI evidence that words containing suffixes that show evidence of decomposition in behavioural studies, such as *-ness*, *-less* and *-*

*able*, are correlated with an increase in neural activity in Broca's area and the basal ganglia, areas in the brain which are associated with procedural memory (71–2). Words containing the suffixes *-ity* and *-ation*, which are accessed whole, are associated with activation of the medial temporal / parietal circuit, an area which is associated with declarative memory (Ullman et al 1997, cited in Vannest et al 2005: 67). Vannest et al claim that there is significant evidence, both 'behavioural and neuropsychological', to support a 'dual-route declarative / procedural model' which is sensitive to structural differences in words such that 'not all complex words are processed identically' (74). The theories which assume this dual involvement deviate with regards to the specific ways in which the two routes interact. Furthermore, it is worth noting that the parsing route is generally considered to be the slower of the two, because there are more computational steps involved in decomposing complex forms.

The dual-route models in the literature include the Augmented Addressed Morphology (Caramazza et al 1988, Chialant and Caramazza 1995); the Morphological Race Model (Frauenfelder and Schreuder 1991); and the Meta-model for Morphological Processing (Schreuder and Baayen 1995). The first of these, the Augmented Addressed Morphology Model (AAM), assumes that both the parsing and whole word access routes are activated simultaneously and operate in parallel when a known morphologically complex word form is encountered, initiating a race between the routes. However, the "race" is anything but, for the model explicitly assumes that there is no 'overlap in the temporal distribution of the processing times' of the two routes, and that the whole word access route will always be faster at activating the recognition of known words than the decomposition route (Frauenfelder and Schreuder 1991: 170). The model further assumes that 'lexical access to morphologically complex words takes place through ... morpheme sized access units for unfamiliar morphologically regular words' (Chialant and Caramazza 1995: 63). The decomposition route in the AAM therefore appears to be a back-up, intended for the purpose of processing unfamiliar words, implying that in this respect the model is similar to direct access models such as Butterworth's Full Listing Hypothesis.

Unlike the AAM, the Morphological Race Model (MRM) allows for some temporal overlap between the processing times of the whole word access and parsing routes. Frauenfelder and Schreuder's model inherits from Baayen's (1991) Race Model, and both race models differ from the AAM in that there is no overt stipulation that the direct access route will always reach completion first. The two routes again compete in parallel, but the time taken to recognize a word form depends on a number of factors, such as the type and token frequency, which affects the resting activation level of the whole word form, as well as the phonological and semantic transparency of the word, and the distributional properties of the word's constituent morphemes. If a successful parse can be completed before the direct access route retrieves the word form, the parsing route is the "winner". This is more likely to occur in the case of low frequency, semantically transparent forms which contain productive affixes. Although including both whole word and decomposed representations contravenes the economy of storage constraint, Frauenfelder and Schreuder claim that the 'overall speed of performance' is faster in a race model

compared to a single system model, and that the gain in processing speed will outweigh the storage costs (1991: 179). Within the MRM, therefore, the parser is more than just a back-up procedure used only to process unfamiliar words; it is used to aid recognition of known forms, and is therefore ‘integrated more directly in the lexical processing system’ (181). However, the MRM does not make any predictions about the ‘storage of regular inflectional forms of relatively high frequency besides storage of irregular forms.’ (Booij 2007: 244)

Schreuder and Baayen’s (1995) Meta-model for Morphological Processing (MMM) in turn inherits a number of features from the MRM, while presenting a detailed description of the stages involved in the parsing route as well as their proposed nodal representation of the mental lexicon. The MMM also stipulates that regular forms may be accessed by either route, depending on the frequency of the word and its constituent morphemes. Crucially, the MMM differs from its predecessors in that there is no element of competition between the routes. Instead, the parser and the whole word access routes ‘interactively converge on the desired meaning representations’ (Schreuder and Baayen 1995: 151). While the two routes do work in tandem, there is no theoretical stipulation that prevents either of the routes from taking a stronger role in the access of a particular word, such that it is possible that the whole word access route dominates the decomposition route in the access of high frequency, morphologically regular complex words.

### 3.3.3.1 *Experimental Data — Plag and Baayen (2009)*

A recent study by Plag and Baayen (2009) also appears to provide experimental data in support of dual-route models. In their 2009 paper, Plag and Baayen collected data concerning lexical decision tasks and word-naming latencies from the English Lexical Project database (Balota et al 2007) in order to study the respective roles of computation and storage in lexical access. By using mathematical models to analyse the relationship between a number of frequency measures and the word-naming latencies, they found that a suffix’s rank in the Complexity-Based Ordering hierarchy had a significant effect on the speed of lexical processing, such that their predictor Mean CO-rank was a ‘relevant predictor for processing complexity’ in both behavioural tasks (Plag and Baayen 2009: 136). However, they found that only suffixes with a Mean CO-Rank of either extreme would enjoy processing advantages. Plag and Baayen argue that this can be seen as a result of the relationship between the constraints of processing and storage, and model this by means of a quadratic polynomial with Mean CO-Rank as one of the variables in the equation. The equation was formulated as follows:

$$y = a' + \underbrace{c' \cdot (1 - x')}_{\text{computation}} \cdot \underbrace{(x')}_{\text{storage}}, (c' > 0)^5 \quad (2009: 139)$$

---

<sup>5</sup> Where  $y$ , the median latency of naming, is a function of the storage and processing constraints represented by  $x$ .

The equation in (1) can also be represented as a graph, shown below in Fig. 3.1:

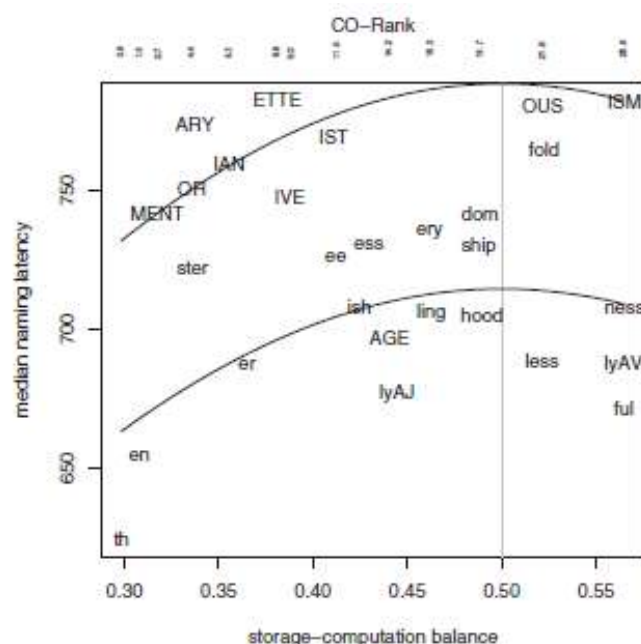


Fig. 3.1

(2009: 140)

The above graph also indicates the derived relationship between the Mean-CO Rank and the storage-computation coefficient. Suffixes marked with the feature [+Latinate] are indicated in uppercase letters, and are represented by the higher of the two inverse regression curves. It is apparent that the median naming latency, the time taken to retrieve a word from the lexicon, is at its highest when  $x' = 0.50$ . That is to say, when the mutually opposed routes of storage and computation are equally likely, no processing advantage is gained by choosing one route over the other. Past this point, the median naming latency begins to fall, showing that the computational route has become more advantageous, as per the claims of Complexity-Based Ordering that ‘outer affixes’, those arranged to the right of the CBO hierarchy, are ‘more easily parsed’ (138). It is notable that the asymmetry of the curves implies that ‘memory-based processing apparently offers greater advantages than decomposition-driven processing’, which may provide an explanation for such phenomena as semantic drift or semantic opacity, both of which ultimately reinforce the whole word access route (139).

### 3.3.4 Network Model

The usage-based model proposed by Bybee (1985, 1995, 2001) is similar to mixed models of lexical access addressed above, in that a basic assumption of this model is that speakers are capable of accessing linguistic units either by ‘storing (them) in their mental lexicon’ through learning them by rote, or by ‘combining semantic notions by concatenating linguistic units’, where the concepts ‘rote’ and ‘combination’ correspond with the whole word and decomposition routes (1985: 111–2). As we have seen

in §2.1, in Bybee's model, every item in the mental lexicon has a large number and type of lexical connections to other lexical items. Morphological relationships arise from overlaps in terms of the orthographic, phonological and semantic properties of lexical items; these overlapping nodes form word families. Within the theory of lexical connectivity, the lexical frequency effect is explained in terms of the strength of connections that exist between words. Low frequency complexes form stronger connections than high-frequency ones, which represents the fact that 'low frequency items are analyzed and understood in terms of other items, while high frequency words, complex or not, may be autonomous' (1985: 123–4). The main difference between this model and the other dual access models is the way in which 'the links expressing similarities and relations between words are implemented' (Schreuder and Baayen 1995: 152). The MMM distinguishes between the form and the meaning of words by positing different concept nodes for the two aspects, while the connectionist model does not. This is illustrated in the experiment described above [Bybee and Slobin (1982)], where the results are predicated on the assumption that semantic knowledge is a factor in forming morphological relationships between lexical items. In other respects, however, the connectionist model captures many of the theoretical generalizations that are held by the MMM. Network models are thought to be minimally redundant, in that they 'offer the merging of rules and representations' (Baayen 2007: 95). However, this generalisation cannot be supported in light of the neurological data discussed in the work of Jaeger, Beretta et al and Vannest, Polk and Lewis (§3.3.3, above) which demonstrates that they are associated with 'distinguishable neural substrates' (95).

### 3.4 *Lexical Access and Lexical Stratification*

Though the majority of the lexical access theories discussed above are situated in the psycholinguistic tradition, the findings are not incompatible with other morphological theories. The dual-route model representation of lexical access discussed above appears to be implicitly encoded in the theoretical apparatus of the lexical stratification model of morphology, such that the 'distinction between suffix types ... is not only a behavioural result, but also grounded in linguistic theory' (Vannest, Polk and Lewis 2005). It should be noted that the fMRI data collected in Vannest et al's paper was elicited from experiments conducted in a lexical stratification framework. The experimental data presented below provides further justification for this claim.

#### 3.4.1 *Experimental Data — Vannest and Boland (1999)*

The dual-route model of lexical access predicts that semantic opacity facilitates the whole word access route over the decomposition route, a hypothesis which is supported by experimental data from Vannest and Boland (1999). It should be noted that their model is based on Kiparsky's (1982) affix-driven Lexical Phonology and Morphology instead of a base-driven stratification model, but the results elicited are not inconsistent with the latter. The underlying assumption is that frequency effects elicited in their



lexical-decision experiments reflect the time taken to access a word in the mental lexicon (Vannest and Boland 1999: 325). Two different sets of stimuli were chosen, Root-Contrast pairs and Whole-Word Contrast pairs. The former set comprised words matched for whole-word frequency, but varying in terms of the frequency of the Root, while the latter comprised pairs matched for Root frequency and varying in terms of Whole-Word frequency (325). The results showed that in the case of words containing affixes associated with Stratum 1, namely *-ity* and *-ation*, only the ‘frequency of the full suffixed forms ... affected response times, indicating that the full form is the only one (being) accessed’ (328). However, in the case of words containing the Stratum 2 affix *-less*, it was found that ‘root frequency influenced recognition times’ (328). This would only be the case if the roots themselves were being accessed from the lexicon, which thus supports the argument that Stratum 2 forms are more likely to be accessed via the decomposition route. Vannest and Boland also demonstrate that some Stratum 2 forms are accessed whole, which is consistent with Hay’s claim (cf. §3.2) that a high relative frequency may ultimately reinforce the whole word access route, in spite of morphological regularity (Vannest and Boland 1999: 330). They also argue that the lack of phonological changes, semantic transparency and productivity, all of which are associated with stratum two forms, may facilitate the decomposition route in words containing such affixes (331–2).

### 3.5 *Summary*

The overview and discussion of the three commonly discussed models of lexical access presented in this chapter has argued that the dual-route model of lexical access, incorporating both a whole word look-up process and a morphological parser, is the most psychologically realistic model, in light of factors such as frequency, lexical search mechanisms and other psycholinguistic constraints. Such models capture generalizations and theories about the organisation of the mental lexicon of English speakers that can be tested through a variety of lexical experiments. It is also worth noting that the models of Schreuder and Baayen, as well as Bybee, for example, are also applicable cross-linguistically, and not just to the study of English. Furthermore, the apparent link between the overwhelmingly psycholinguistic lexical access models and the lexical stratal model, demonstrated by Vannest and Boland’s experiments, indicates that perhaps there is more work to be done to investigate further links and theoretical overlaps between the two, seemingly disparate theoretical paradigms in order to provide more insights about the theory of English morphology. This notion will be pursued in greater detail in the following chapters.

# Chapter 4:

## Affix Order and Bracketing Paradoxes

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### 4.0 Introduction

In the previous chapter, we saw that theorists arguing in favour of the dual-access model of lexical access supported their claims by citing experimental data from a number of neuro-imaging studies. Importantly, we saw that neuro-cognitive experiments conducted by Vannest and Boland (1999) and Vannest et al (2005) appear to provide evidence in support of lexical stratification. This opens up the possibility that lexical stratification and cognitive-based approaches have some common ground. In this chapter, we will investigate several specific linguistic phenomena that have proved equally problematic for stratal models of morphology and the psycholinguistic approach. This includes a number of unexpected affix combinations as well as bracketing paradoxes. By examining the ways in which the problematic data are accounted for, this chapter hopes to show that the two theoretical approaches are not as dissimilar as has been suggested.

### 4.1 Affix Combinations

Hay and Plag have argued that their cognitive-based approaches — Hay's Complexity Based Ordering, Plag's selectional restrictions and indeed a potential synthesis of the two — are both conceptually more interesting and empirically more accurate than stratal models. While this may be the case for the affix-driven models, it will be shown that Giegerich's base-driven stratal model is not susceptible to the same criticism. In addition, there are still some specific cases in which the parsing generalisations cannot fully account for an attested combination of affixes. Plag identifies three specific combinations, *-able-ity*, *-al-ize-ion* and *-al-ist* as being difficult to account for within Hay's theory. As we will see, the base-driven stratal model is better equipped to deal with certain combinations that are unaccounted for in the cognitive approaches.

#### 4.1.1 *-abil-ity*

Hay's Complexity Based Ordering (CBO) theory incorrectly predicts that the combination *-abil-ity* is unacceptable. The junctural phonotactics created by the affixation of *-able* suggests that the suffix should be more easily parsed out than *-ity*. While the affixation of vowel-initial suffixes generally creates high probability junctural phonotactics, thus obscuring the complexity of the derivative, *-able* is stress-neutral while the affixation of *-ity* results in a stress shift. In terms of Hay's affix hierarchy therefore, the combination *-able-ity* is thus automatically ruled out. However, Plag notes that the 'facts show ... the most extreme opposite' as '*-able* base-selects *-ity* productively' (2002: 293). In addition, though Hay makes no

mention of the ranking of the affixes relative to each other, she does note that the pairing of *-able-ity* is ‘surprising ... due to the frequency characteristics of the affixes’, which suggest that the ‘outermost affix should be less separable than the innermost’ (Hay 2003: 181). This “surprising” behaviour extends also to the combinations *-ize-ation*, *-is-itic* and *-ment-al*, which will be discussed in greater detail in the following sub-sections. It is worth noting that in Plag’s theory of base-driven selectional restrictions these suffixes are easily accounted for, as ‘*-ize* obligatorily takes *-ation* as nominalising suffix’, while *-able-ity* and *-al-ist* are formed through ‘[a]nalogous arguments’ (2002: 293).

In affix-driven stratal models too, the combination *-able-ity* is obligatorily ruled out by the Level Ordering Hypothesis, which prevents Class I *-ity* from attaching outside Class II *-able*. To reconcile this, theorists have long argued in favour of *-able* belonging to both strata (Aronoff 1967; Selkirk 1982). Selkirk, for instance, argues that *-able*, along with its allomorph *-ible*, is affiliated with both strata, but does not view this as a counterargument to the Level Ordering Hypothesis. Instead, the dual-stratal membership of *-able*, as well as *-ment*, *-un* and *-ize*, is considered an exception to an otherwise regular affix ordering system. In Giegerich’s base-driven approach however, the dual-stratal behaviour of *-able* is unproblematic. The suggestion that *-able* belongs to both Stratum 1 and 2 is in fact supported by the existence of the allomorph *-ible*; such base-distorting phonological behaviour is characteristic of affixation on Stratum 1.

In the discussion of bracketing paradoxes (below, §4.2ff) we will return to more instances in which the division between Class I and Class II affixes incorrectly rules out attested forms.

#### 4.1.2 *-ist-ic*

This suffix combination is one that Fabb identified as being difficult to reconcile with the Level Ordering Hypothesis, given that *-ist* is traditionally thought to be a Class II suffix. The suffix *-ic* on the other hand, given its base distorting behaviour, is clearly a Class I affix. In a base-driven approach, *-ic* is similarly a Stratum 1-only affix. Nominalising *-ist* is attested with bound Roots and Words — *fascist*, *plagiarist*; as well as *sexist*, *rightist* — which indicates that it does attach on Stratum 2. However, behaviour associated with the latter’s derivatives suggests that *-ist* has dual-stratal membership — Giegerich notes that there are forms ending in *-ist* which display stress behaviour and base distortion associated with Stratum 1, as well as forms such as *capitalist* in which *-ist* appears to be stress neutral (1999: 42–3). The combination is unproblematic as long as *-ic* selects only Stratum 1 *-ist* forms; unfortunately this is not the case. Stratum 1 *-ic* can in fact select for an unpredictable set of *-ist* forms which appear to be formed on Stratum 2. To account for this Giegerich suggests that free bases which can affix with *-ist-ic* should be assigned to Stratum 1.

Although this otherwise unmotivated stratal assignment is what Plag specifically cites as a weakness of the base-driven stratal model, it appears as though the combination of *-ist* and *-ic* is not

predicted by CBO either (2003: 173). Both *-ist* and *-ic* are not ‘highly parsable’ affixes, which entails that affixation does not result in improbable junctural phonotactics (Hay 2003: 181). However, like the pair *-able* and *-ity*, the frequency characteristics of the affixes suggest that *-ist-ic* should not be a valid suffix combination.

#### 4.1.3 *-al-ize-ion*

The combination *-al-ize-ion*<sup>6</sup> also proves to be problematic for CBO. In Hay’s account, the combination *-ion-al* is an acceptable sequence. Although *-ion* is said to be highly resistant to decomposition, *-al* can ‘tolerate some degree of internal structure’ (2000: 263). This correctly predicts that when concatenated *-ion* should be located closer to the base than *-al*. However, Plag shows this directly contradicts the generalisations gained from the productive sequence *-al-ize-ion*, which suggest that *-al* is less decomposable than *-ion*. This leads to the problem that ‘*-al* must be at the same time more easily parsable than *-ion*’, such as in the word *sensational*, while also being ‘less easily parsable than *-ion*’ where it appears in the word *colonialization* (263). In their 2004 collaboration, Hay and Plag revisit this problem to test the hypothesis that the contradictory behaviour of *-al* and *-ion* can be attributed to word frequency effects. Though they do find that ‘*-ize* forms preferentially attach to *-al* forms containing low levels of decomposability’ — those in which the *-al* derivative is more frequent than the base to which it is attached — they do not suggest why this translates to the productive combination *-al-ize-ion* (Hay and Plag 2004: 592).

#### 4.1.4 *-al-ist*

The combination of *-al* and *-ist* is similarly problematic. Given that *-al* can attach to specific morphological complexes, and that *-ist* only attaches to ‘unparsable or weakly parsable bases’, the combination *-al-ist* should either be ruled out completely, or should only occur with bases ending in *-al* that have a high relative frequency (Plag 2002: 293–4). However, Plag’s analysis of 34 neologisms containing the combination *-al-ist* shows that in the ‘vast majority’ these forms are a result of *-ist* attaching to ‘*parsable bases* ending in *-al*’, those with a high relative frequency (295, emphasis KM). Plag argues in favour of selectional restrictions, as he claims they are more accurate in predicting affix combinations. However, the ‘grammatical restriction’ that governs the attachment of *-al* and *-ist* — that is, ‘*-al* base-selects *-ist* productively’ — more closely resembles an observation than a restriction (295).

In Giegerich’s base-driven stratal model, adjectival *-al* is attested with both bound Roots — *social*, *final* — as well as Words — *cantonal*, *baptismal* —, but the stress shifting behaviour associated with the affix

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<sup>6</sup> This discussion follows Hay and Plag (2004) where *-ion* is used to refer to the allomorphs *-ion*, *-ication* and *-ation*

(cf. *báptism* ~ *baptísmal*) marks it as a Stratum 1-only affix (1999: 13–4, 48). As we have seen in §4.1.2, *-ist* can attach on both Stratum 1 and 2 which accounts easily for the productive combination *-al* and *-ist*.

#### 4.1.5 *-ment-al*

The suffix *-al* was deemed problematic by Fabb, as he had difficulty accounting for its distribution. While the [+Linate] feature can be used to explain the affixal behaviour of the equally “problematic” *-ion* — such that *-ion* attaches exclusively to verbal bases marked [+Linate] — he notes that this ‘does not work so well for *-al*’ (1988: 536). Fabb eventually concludes that either *-al* affixation involves either several ‘(unknown) selectional restrictions’, or that ‘*-al* ... attaches to underived words and to three specified affixes [i.e. *-ion*, *-ment*, *-or*]’ (536, brackets NF). However, while Fabb cites the ill-formedness of affix pairs like *\*-ism-al* *\*-ity-al* as evidence that *-al* fails to attach to [+Linate] bases, Plag argues that the non-occurrence of these forms is a result of type blocking. Given the base-driven nature of Plag’s theory, he claims, *contra* Fabb, that ‘*-al* attaches almost exclusively to Linate bases’ (2003: 95)

However, neither of these approaches provide an explanation that will account fully for the distribution of *-al*, as neither author explains why *-al* only attaches to a specific sub-set of forms ending in *-ment*. Fabb claims that one possible explanation is that the suffix *-ment* is assigned a feature  $\varphi$  that *-al* then selects for, although he does not specify a feature that could account for all the forms attested with the combination *-ment-al* (538). We turn instead to the base-driven stratification model for an explanation.

Giegerich finds that nominalising *-ment* attaches to bound Roots as well as verbs marked as [+Linate]. As we have seen however, attachment to bound Root is no longer a diagnostic for stratal membership. The crucial property of *-ment* is that it fails to ‘attract a further suffix in some but not all instances’ (Giegerich 1999: 48). There is a distinctive pattern to *-al* affixation, which is related to the category specification — or lack thereof — of the bases ending in *-ment-al*. This is set out in (1) below:

(1) (a)	<i>ornament*</i>	<i>orna<sub>R</sub></i>	<i>ornamental</i>
	<i>increment*</i>	<i>incr<sub>R</sub></i>	<i>incremental</i>
(b)	<i>employment</i>	<i>employ<sub>V</sub></i>	<i>*employmental</i>
	<i>discernment</i>	<i>discern<sub>V</sub></i>	<i>*discernmental</i>
(c)	<i>government</i>	<i>govern<sub>V</sub></i>	<i>governmental</i>
	<i>development</i>	<i>develop<sub>V</sub></i>	<i>developmental</i>
	<i>judgement</i>	<i>judge<sub>V</sub></i>	<i>judgemental</i>

(from Giegerich 1999: 55)

Giegerich notes that the combination of *–ment–al*<sub>A</sub> attaches freely to bound roots, but is only attested with three specific free bases: *government*, *development* and *judgement*. As such, the forms in (1a) and (1c) are thought to belong to Stratum 1 while those in (1b) belong to Stratum 2. The fact that the forms in (1c) are assigned to Stratum 1 is supported by the ‘somewhat idiosyncratic meanings’ of the three *–mental* derivatives, as ‘semantic non-compositionality’ is a trait commonly associated with Stratum 1 forms (48).

In her analysis of the same suffix combination, Hay shows that *–al* affixation is strongly influenced by the internal structure of the base. The suffix displays a strong preference for minimal structure, which accounts for the fact that *–al* attaches freely to monomorphemic Root forms. The forms in (1c) are morphologically complex, but Hay suggests that ‘[t]he degree to which *–al* suffixation is bad with *–ment* forms is related to the degree to which these words are decomposed’ (2002: 549). In fact, in Hay’s account the key factor is that the forms *government*, *development* and *judgement* are more frequent than their bases, and so may favour the whole word route in access. This in turn entails that it is possible that they have developed independent representations in the lexicon, thus appearing in some way to be monomorphemic candidates for *–al* affixation. This is also consistent with Giegerich’s suggestion that the forms in (1c) above are exceptionally stored in Stratum 1. The stratal assignment is motivated by the fact that they are ‘semantically non-compositional’, and is supported by Hay’s claim that complex forms which ‘are more frequent than their bases’ that is, those which are more likely to be accessed whole, ‘are significantly more prone to semantic drift’ (Giegerich 1999: 48; Hay 2002: 530).

In this section we have seen that there are a number of suffix combinations that appear to counter the claims of a number of models of morphology, both cognitive-based and stratal. The facts of *–ment–al* affixation are of particular interest, given that the two different theoretical approaches discussed appear to arrive at very similar conclusions about the behaviour of *–al*. In addition, the puzzling characteristics of *–ist–ic* attachment show that, as of now, there is no single theory of morphology that can wholly account for the attested behaviour of English derivational affixes.

In the following section, we turn to a discussion of bracketing paradoxes.

## 4.2 Bracketing Paradoxes

The term bracketing paradox is used to refer to words that, although well-formed, express a ‘conflict between the internal structure suggested by formal considerations ... and the structure suggested by the word’s meaning’ (Carstairs-McCarthy 1992: 40). The existence of bracketing paradoxes is particularly troubling for traditional affix-driven stratal models, though as we will see, in certain specific cases the cognitive-based approaches are similarly unable to account for combinations of prefixes and affixes.

There are three main examples of bracketing paradoxes in the literature: the first involves what at first glance appears to be a violation of Siegel's Level Ordering Hypothesis, while the second is related to the sub-categorisation requirements of affixes, with a specific focus on comparative *-er*. The third commonly cited example arises from what appears to be the affixation of Class I affixes to compounds.

Carstairs-McCarthy writes that within the traditional models, there are two main approaches to resolving bracketing paradoxes; these will be examined in turn. The first such approach is to 'treat the grammatically motivated bracketing as definitive', and is predicated on the reasoning that the 'discrepancy between morphological structure and meaning' is the concern of the component of the grammar that 'deals with lexical semantics' (1992: 93). A second approach to reconciling bracketing paradoxes is one which attempts to 'bring the ... grammatical bracketing into line with the semantic' (93). In addition, there are the resolutions offered from a psycholinguistic approach.

#### 4.2.1 *Ungrammaticality*

At first glance the word *ungrammaticality* appears to be a classic example of the bracketing paradox: the derived complex appears to violate Siegel's Level Ordering Hypothesis in that the "+- boundary", nominalising *-ity* is attached outside a derivative containing the Level 2 prefix *un-*. It cannot be a simple case of the affixation of Class I *-ity* preceding that of Class II *un-*, because the negative prefix *un-* does not select nouns as a base for attachment. Therefore, in order to form the noun *ungrammaticality*, *-ity* has to attach to the adjective *ungrammatical*. Ignoring for now the morphological structure of the complex form *grammatical*, the category-specific selectional restrictions of *un-* suggests that *ungrammaticality* has the internal structure below in (2):

- (2) [[un[grammatical]]ity]

To reconcile this with the Level Ordering Hypothesis inherent to most affix-driven stratal models, theorists have offered a variety of solutions.

Turning first to a cognitive-based solution, it appears at first that the cognitive approaches of Hay and Plag may be paradox-free. As we have seen in §2.3ff, Hay's system of affix ordering relies on the decomposability of affixes and their frequency of use, not the division of derivational suffixes into two extrinsically ordered groups. Instead of the definition offered by Carstairs-McCarthy, Hay uses the term bracketing paradox to refer to words in which a marginally parsable affix seems to have been attached outside a complex form containing a highly parsable affix. She identifies two possible structures, below in (3) and (4):

- (3) [(highly parsable affix)(base)](marginally parsable affix)  
 (4) (marginally parsable affix)[(base)(highly parsable)]

While both are non-optimal configurations, Hay notes that the configuration in (4) is even less preferable, as the affixation of the marginally parsable prefix renders the complex essentially unparsable. Based on Hay's Affix Ordering Hierarchy, which states that 'any suffix below a given suffix on the hierarchy can precede that given suffix but not follow it', the word *ungrammaticality* has the same "unparsable" structure as the example given in (3); the prefix *-un* is neutral, and as we have seen, *-ity* affixation results in base distortion (2004: 572).

Given the apparent failure of the Affix Ordering Hierarchy, Hay argues that the paradox of *ungrammaticality* can be resolved with reference to the frequency count of the base; if *ungrammatical* has a higher frequency than *grammatical*, it is possible that *-ity* affix is licensed because the internal structure of *ungrammatical* has been obscured. As this is not the case, the paradox is not satisfactorily resolved. While Hay argues that the well-formedness of words such as *ungrammaticality* is evidence against stratal models, it appears as though the CBO cannot provide a satisfying resolution to this paradox either.

In her discussion of *ungrammaticality*, Siegel defends the Level Ordering Hypothesis by arguing that the form's internal structure does not exemplify an ordering violation. Instead she contends that *un-* is a Class I affix. Her argument is predicated on the ill-formedness of 'words of the form *un-X-less*' (1974: 183). Based on its morphophonological behaviour, adjective-forming *-less* unquestionably belongs to Class II. According to Siegel, the fact that *un-* cannot attach to forms containing *-less* is evidence that the prefix belongs in Class I. As such, both *-ity* and *un-* belong to Class I, and *ungrammaticality* is a well-formed output of Class I affixation.

Similarly, Selkirk also suggests that *un-* has Class I membership. However, unlike Siegel, Selkirk argues that like *-able*, *-un* has dual-stratal membership. This is supported by the fact that 'there is no phonological evidence' that proves that *un-* is not simultaneously 'a member of the same affix class as *in-* [i.e. Class I] and ... the same class as *non-* [Class II]' (1982: 102). In addition, Selkirk claims that the sequencing of prefixes is not defined by level ordering.

Selkirk's argument for dual-membership status of *un-* is supported by forms such as *redefinition*. The prefix *re-* is attested as attaching outside compounds, as in *re-undercut*, which suggests that it is a Class II prefix. However, if *re-* belonged only to Class II, *redefinition*, formed by the concatenation of *redefine* and Class I *-ition*, would then be affected by the *ungrammaticality* paradox. In addition, this line of reasoning does not explain the 'nonapplication of Level 1 phonological rules to words like *unpopularity* and *unreceptivity*' which would otherwise be realised as *\*unpopularity* and *\*urreceptivity* respectively (Ishihara 1995: 34). Selkirk's argument is not completely satisfying.

The second approach to resolving bracketing paradoxes is to argue that paradoxical words are anomalous 'from a level ordering point of view' (Carstairs-McCarthy 1992: 92). For example, in Kiparsky's (1982) 'Lexical Morphology and Phonology', he notes that words like '*ungrammaticality*,



*unintelligence* and *untruth*’ appear to be structurally mismatched (1982: 12). To resolve this, Kiparsky argues that these words are derived when ‘words idiosyncratically retain their internal bracketing so that word formation processes can apply to the inner constituent at level 2’ (12). The derivative would be reanalysed as follows, from (5) to (6)<sup>7</sup>:

(5) [un[[grammatical]ity]]

(6) [[un[grammatical]]ity]

This means that at Kiparsky’s Level 2, the prefix *un-* has access to the morphological structure of the noun *grammaticality*, a well-formed output of Level 1, and selects the adjective *grammatical* as a base for attachment. However, as we have seen in §1.2.2, Kiparsky’s model adopts the Bracket Erasure Convention, such that morphological brackets are usually erased at the end of each Level. The stipulation that ‘particular words’, such as *ungrammaticality*, need not adhere to this convention is not independently motivated, and ultimately weakens the theory (29).

#### 4.2.2 Uneasier

Sproat argues that a second type of paradox is exemplified in the complex word *uneasier*. The inflectional suffix *-er* only selects for monosyllabic or disyllabic fore-stressed adjectival bases; this phonological distribution would prevent the affix from attaching to trisyllabic complex *uneasy*. Therefore, it follows that *uneasier* should have the following internal structure in (7):

(7) [un[[[easy]er]]].

As Sproat points out, this bracketing gives rise to a meaning similar to “not more easy”. However, *uneasier* should correctly be interpreted as ‘the comparative for[m] of the (idiomatically interpreted) adjectiv[e] *uneasy*’ (1998: 343, brackets RS). To arrive at the latter, intuitively more correct interpretation, *uneasier* must instead be bracketed as in (8) below:

(8) [[[un[easy]]er].

This suggests that there is a ‘mismatch between the structural representations of the words at two different levels of the grammar’ (343). Given that in Sproat’s theory morphemes are considered to be ‘pairs of phonological and syntactic entities’, he argues that (7) and (8) above are motivated on phonological and syntactic grounds respectively. The two representations are related by the operation of the Mapping Principle, formalised overleaf:

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<sup>7</sup> Example (2) is reproduced here as (6).

If A and B are *sisters* in (word-)syntactic structure, and if B is an affix, then the phonological representation of B, denoted as  $\Phi(B)$ , *attaches* to the phonological representations of A,  $\Phi(A)$ .

(Sproat 1998: 344, emphasis RS)

The principle can then be restated as follows: ‘if two morphemes are sisters in S-structure [i.e. word syntactic structure], then their phonological representations must be adjacent’ (Carstairs-McCarthy 1992: 141). Since precedence is associative, the Mapping Principle allows the string of morphemes to be re-bracketed in the phonological, or PF level. This level encodes ‘notions implying linear order’ such as prefix and suffix alongside the phonological information that *-er* is sensitivity to syllabic and stress patterns (Sproat 1998: 344). As such, the well-formed output of the PF level must reflect the bracketing structure above in (7), while the S-structure has the form in (8). The Mapping Principle resolves structural mismatch while maintaining the mapping between both levels of representation. For Sproat, the case of *ungrammaticality* is accounted for in a similar manner.

It should be noted that while Sproat’s Mapping Principle appears to be solution enough for both examples of bracketing paradoxes discussed above, Spencer points out that paradoxes with a structure similar to that of that nominal expression *moral philosophy* would be a problem for the Mapping Principle approach. He claims that expressing the relationship between the two forms ‘cannot be done in a single derivation ... without the intervention of some “transderivational” relationship’, implying thereby that ‘it cannot be done derivationally’ (Spencer 1988: 672).

#### 4.2.3 *Nuclear Physicist*

The third example of bracketing paradoxes is related to compound formation in English. As we have seen, the stratal models discussed in Chapter 1 all share the assumption that compounding occurs later in the derivation than Class I affixation. This is concisely summarised in Selkirk’s Compound-Affix Ordering Generalisation (CAOG) which states that ‘Class II affixes may appear inside or outside (native) compounds, while Class I affixes appear only inside (native) compounds’ (1980: 92, brackets ES). This leads to a conflict in the case of compounds like *nuclear physicist*. The COAG entails that the suffix *-ist* attaches to the noun *physics* before the compound is formed. This leads to the bracketing in (9) below:

(9) [nuclear[[physics]ist]]

However, as in the case of *uneasier*, the structure in (9) results in the wrong semantic interpretation. As Carstairs-McCarthy points out, a ‘*nuclear physicist* is someone who does nuclear physics, not a physicist who is nuclear’ (1992: 93). To arrive at the semantic interpretation “someone who does nuclear physics”, the internal structure of the compound must be that in (10).

(10) [[nuclear physics]ist]

Spencer argues that the compound *nuclear physicist* is an example of what he refers to as ‘personal nouns,’ a category which also includes the compounds *chemical engineer* and *moral philosopher* (1988: 673).

To resolve paradoxes of this type by analysing the mapping between morphemes at different levels of representation would involve ‘invoking radical and otherwise unmotivated allomorphy’ (Carstairs-McCarthy 1992: 95). Instead, Spencer suggests that the answer to resolving these meaning paradoxes lies in a lexical semantics approach. His claim is that bracketing paradoxes of this nature arise because of their close semantic relationship to a nominal form. This is formalised in his Lexicalization Requirement, which states that paradoxical constructions are in fact licensed, given that ‘the source expression ... should be lexicalized or perceived as such’ (1988: 675). In (11) and (12) below, the expressions on the right are the source expressions, while those on the left are the derived forms.

- |                               |                        |
|-------------------------------|------------------------|
| (11) (i) Nuclear physics      | (ii) Nuclear physicist |
| (12) (i) Chemical engineering | (ii) Chemical engineer |

Theories proposing reanalysis of mapping between structures, such as that presented by Sproat 1998 (§4.1.2 above), are inadequate, especially in light of forms such as *chemical engineer*. Unlike *nuclear physicist* the formation of *chemical engineer* does not involve any affixation, and so there is no morphophonological material available to be structurally reanalysed. In fact, (12ii) is derived as a result of backformation, where the deletion of morphophonological material is licensed by the source expression *chemical engineering*. Spencer argues that the formation of (11ii) and (12ii) is motivated by the need for a lexical item denoting experts of specialised field. This leads Carstairs-McCarthy to conclude that this need may be met by any ‘item that the grammar (syntax or morphology) renders conveniently available, even if its grammatical structure does not compositionally reflect its meaning’ (2005: 36). We will revisit the idea of lexicalisation in the discussion of phrasal compounds in §5.3.2

The crucial insight to be gained from the analyses of *ungrammaticality* and *uneasier* or, more accurately, the types of paradox exemplified by the two types of construction shows that the bracketing paradox is problematic for a number of theoretical approaches. It appears that no one theoretical approach is able to provide an account of morphology that explains all attested behaviour, which suggests that this is an area for further research.

### 4.3 Summary

Fabb identified that there are two well-known counterexamples that undermine the claims of the Level Ordering Hypothesis. The first such counterexample is that of ‘a few specific pairs of affixes which involve a [Class II] suffix preceding a [Class I] affix’ (1988: 527). As we have seen in §4.1ff, this type of construction is not exclusive to stratal models. The discussion of the affix combinations *-abil-ity*, *-al-ize-ion* and *-al-ist* shows that information about decomposability and the word frequency counts of suffixes

alone is not able to accurately capture generalisation about the combinability of English derivational suffixes. In fact, it is interesting to note that the first of these, namely the combination *–abil–ity*, is also one that Fabb identified as one appears to undermine the Level Ordering Hypothesis (527). Giegerich's base-driven model, on the other hand, remains untroubled by the occurrence of the combination *–abil–ity*.

The second counterexample cited by Fabb was that in which a '[Class I] suffix appears to attach to the output of [Class II] prefixation' (527). As we have seen in, the appearance of bracketing paradoxes is not exclusive to models which have adopted the Level Ordering Hypothesis, namely the affix-driven stratal models discussed in Chapter 1. The case of *ungrammaticality*, discussed in §4.2.1 shows once again that there are specific instances where Hay's parsing generalisations cannot fully account for the observable facts.

The discussion in this chapter highlights that there are issues in English suffixation and compounding that cognitive-based theories and theories of lexical stratification both struggle to account for. At the same time, there are instances in which the two approaches arrive at very similar conclusions. In the following chapter, we will see that there are in fact more areas of overlap between the two approaches.

# Chapter 5:

## Stratal Overlap, Modular Overlap

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### 5.0 *Introduction*

One criticism of the stratal model which is often cited by psycholinguists is that the concept of modularity is psychologically unrealistic. In this chapter we will see that there is a substantial amount of neuropsychological data which demonstrates empirically that cognitive language processing is not simply divided into discrete units in the mind, such that sentence structure is processed in a subcomponent that is completely distinct from the morphological module and vice versa. This evidence is cited in support of cognitive theories in which morphological, semantic and syntactic structures are connected either by networks or associative patterns formed by speakers. Importantly, the concept that associative patterns can connect morphological units with syntax or other any other kind of “post-lexical” information is obligatorily ruled out in most stratal models, because the Lexical Integrity Principle stipulates that the two modules cannot interact. By questioning the necessity of the Lexical Integrity Principle, this chapter will attempt to show that the psycholinguistic data does not conclusively prove that models of lexical stratification are incompatible with the facts of cognitive language processing.

### 5.1 *Lexical Integrity Principle*

A core assumption of lexicalism is that there is a sharply dividing line separating the lexicon and syntax. The lexicon is both the repository of listed items and the site of production of words, which are ‘members of (the) lexical categories’ Noun, Verb and Adjective, while ‘members of phrasal categories’ are produced by the syntactic module (Giegerich 2005b: 43). The separation of morphological and syntactic operations is most clearly expressed in the Lexical Integrity Principle<sup>8</sup> (LIP) proposed by Lapointe 1980, Di Sciullo and Williams 1987, Scalise and Guevara 2005, which essentially states that ‘syntax is blind to the internal structure and composition of words, and cannot affect it’ (Carstairs-McCarthy 1992: 90). This stipulation is arguably one of the key characteristics distinguishing lexical stratification from cognitive models of morphology; unlike cognitive-based approaches, models that adopt the LIP cannot allow for connections to be formed between morphological units and the rules of syntax. As Marslen-Wilson and Tyler note, however, the ‘facts of psycholinguistic performance do not support the rigid dichotomy between the domains of the syntactic and the non-syntactic’ (2007a: 806). In light of this, the arguments against the realism of stratal models of morphology seem to be justified. It is hoped that the following discussion will show that this is not the case.

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<sup>8</sup> As Carstairs-McCarthy notes, the LIP is known by a number of different names, including Generalised Lexical Hypothesis, Strong Lexicalist Hypothesis or Lexical Integrity Hypothesis. The Lexical Integrity Principle is the name we will adopt here

### 5.1.1 *The Modularity of Mind*

It is important to note that the concept of modularity is not completely foreign to psycholinguistics. In his influential monograph ‘The Modularity of Mind’ (1983) Fodor proposes that the mind comprises two kinds of mental structures, the ‘horizontal faculty’ which is independent of subject matter, and ‘vertical faculties’ (2007: 787—3). The latter type of faculty is ‘domain specific’, ‘associated with distinct neural structures’ and is ‘computationally autonomous’ (784). Fodor goes on to argue that to a certain extent, the mind is ‘structured into functionally distinguishable subsystems’, such that cognitive faculties are distinguished from each other in terms of subject matter (785). In other words, a “vertical faculty” is a module. Fodor claims that ‘understanding an utterance involves ... analysis at several different levels of representation’, or “input systems”, which are ‘informationally encapsulated’ (785). This entails language processing operations ‘are in certain respects unaffected from feedback’ from other input systems. The ‘informational encapsulation’ that characterises input systems ‘is the essence of their modularity’ (791).

A crucial factor here is that different modules are associated with ‘distinct neural structures’ (784). The claim that there are specific areas in the brain, neural substrates, involved in processing different types of grammatical constructions is supported by event-related potential (ERP) data from a number of studies (Harley 2001; Gompel and Pickering 2007). There are two different neural responses, known in the literature as N400 and P600, which are elicited by ‘violations of semantic expectancy’ and syntactic violations’ respectively (Harley 2001: 257). Data from ERP studies also shows that sentences containing both semantic and syntactic anomalies elicit both neural responses, which results in the conclusion that semantic and syntactic processes are in fact separable and independent (258). In addition, Vannest, Polk and Lewis demonstrate that the morphological decomposition of complex derivational forms is correlated with an increase in neural activity in Broca’s area and the basal ganglia, while the access of stored forms is associated with neural activity in the medial temporal and parietal regions (2005: 71–2; cf §3.3.3). While it looks as though there is a strong case in favour of modularity, Marslen-Wilson and Tyler show that the issue is not easily resolved.

### 5.1.2 *Against Modularity*

Functional magnetic resonance imaging (fMRI) data from experiments conducted by Marslen-Wilson and Tyler (2007, 2009) initially appears to support the theory of modularity. The authors conducted a series of auditory-auditory repetition priming tasks with regular and irregular past tense forms in English, and found that the ‘neuro-cognitive processes mediating access for [stored forms] are separable from those mediating access for regularly inflected forms’, that is, forms which are decomposed on access (2007: 825–6). However, they also found that the retrieval of ‘lexico-semantic information’ — stored forms — is associated with neural activity in the ‘temporal lobe structures, centred around the

posterior superior and middle temporal gyri' (2007: 828). The retrieval of regularly inflected past tense forms is associated 'left inferior frontal gyrus [LIFG], as well as the superior temporal gyrus [STG] and middle temporal gyrus [MTG]'. In other words, there is a significant area of overlap in terms of the area concerned with processing listed and fully decomposed forms.

More evidence against the theory of modularity comes from the study of syntactic and semantic processing. Tyler and Marslen-Wilson conducted experiments designed to study the neural substrates associated with processing semantic and syntactic constructions. Respondents were presented with a series of spoken sentences that contained either a semantic or syntactic ambiguity. A sample sentence is '[s]he quickly learned that injured calves...' where the ambiguity of the word "calves" is only resolved when the sentence is completed. Similarly, in the sentence '[o]ut in the open, flying kites...' *flying kites* can be either a noun or verb phrase (2009: 209). The results of the fMRI studies were compared against what the authors refer to as 'dominance ratings', which is an 'estimate of the extent to which one reading ... was preferred by listeners' (208). Neuro-imaging shows that activation in the 'LIFG ... and a large swathe of the left medial temporal gyrus [LMTG], extending anteriorly into the anterior STG and posteriorly to the inferior parietal lobule' increased when the context disambiguated syntactic ambiguity, while the resolution of semantic ambiguity was associated with neural activity mainly in the LIFG, as well as the 'mid portion of the MFG' (208). In other words, the area associated with semantic processing is a subset of the area of the brain associated with syntactic processing.

This data, in conjunction with neuro-imaging data demonstrating the connection between the processing of inflectional morphology and syntactic information, prompts Tyler and Marslen-Wilson to conclude that their investigations 'point to a set of partially dissociable sub-systems supporting three major aspects of spoken language comprehension, involving regular inflectional morpho, sentence-level syntactic analysis and sentence level-semantic interpretation' (216). While the different aspects of language processing are, as Jaeger et al 1996, Beretta et al 2003 and Vannest et al 2005 demonstrate (cf §3.3.3), associated with certain key neural substrates, language processing is not confined to these areas. Instead '[n]o one region or sub-region holds the key to a specific language function; rather each requires the co-activation of activity within a number of different regions' (Tyler and Marslen-Wilson 2009: 216).

It is clear therefore, that the neuro-imaging data has significant repercussions for the theory of lexical stratification. As long as the LIP stipulates that lexico-semantic content cannot interact with syntactic processing, stratal models must be seen necessarily be seen as untenable. In the following sections, however, we will see that this is not the case. Instead, it will be argued that the LIP cannot be maintained, or at the very least must be weakened. The assumption is that stratal models that adopt a weaker version of the LIP can be maintained, even given the neuro-cognitive data.

## 5.2 Overlapping Strata

The division between the two modules of the grammar is thought to be mirrored by the stratification of the lexicon. The suggestion being made here is that muddying the boundary between the strata could imply that the boundary between lexicon and syntax is not sharply articulated. To recap, the Kiparsky's Bracket Erasure Convention prevents morphological operations on any given Level from accessing the internal structure of forms derived on an earlier Level. However, as we have seen in §4.2.1, in order to account for the grammaticality of *ungrammaticality* Kiparsky proposed weakening the Bracket Erasure Convention. It appears therefore that the division between strata is not as impermeable as was originally proposed. In addition, Hay's review of Siegel's affix classes (§2.3.4) shows that the predictions made in the Level Ordering Hypothesis are not always correct. The affix combinations discussed in Chapter 4 also seem to indicate that maintaining a strong division between lexical strata is more costly than allowing for some element of overlap between strata. It must be noted that Giegerich's base-driven stratal model is predicated on such an overlap, given that affixes are not constrained to a single stratum but may attach on both. As we have seen, Giegerich argues instead that 'any two contiguous strata in English ... are partially-overlapping domains by virtue of the fact that their morphological base categories constitute a natural class' (1999: 98). This claim will be investigated in greater detail in the sections below.

Giegerich's argument in favour of overlapping strata is supported by a number of phonological operations that are shared by both Stratum 1 and 2 forms. In general, Stratum 1 forms are characterised by a number of base-distorting phonological processes, including stress and syllabicity alternations, the application of 'stratally restricted phonological rules', such as Trisyllabic Shortening, as well as semantic opacity and non-productive morphological processes. Conversely, Stratum 2 forms are generally 'phonologically, morphologically and semantically' transparent (1999: 97). However, there are instances where Stratum 2 forms fail to 'preserve main stress on the base', which results in pairs such as *élémentary* and *èlementàrihly*, which appears to be a result of the 'right-to-left, weight-sensitive stress assignment' associated with Stratum 1 and with [+Linate] forms (2005b: 54). Given the non-structure changing nature of Stratum 2 *-ly*, the stress pattern of the derivative should be *elementarily* instead. In addition, Giegerich notes that there are cases of Stratum 1 forms – both derived (as in *sensàtionàlity*) and monomorphemic (*Tìconderóga*) — that have stress patterns identical to that of Stratum 2 forms (54). Assuming that there is in fact an area of stratal overlap in which Stratum 1 stress patterns can apply to Stratum 2 and vice versa offers a "cheap" — in terms of processing demands — and simple solution to two otherwise exceptional processes.

Giegerich notes several other phenomena that suggest that phonological operations may overlap between Stratum 1 and 2. Stratum 2 forms are allowed to have phonological realisations that would be prevented from occurring morpheme-internally, such as geminates or illegal clusters (like the /pf/ in *pipeful*). However there are instances in which Stratum 2 forms are simplified, such as the words *wholly* and



*fully* being realised without a geminate (Jones 1997, cited in Giegerich 2005b: 56). Attributing the simplification to lexicalisation is not motivated by any other factors; both words are still fully transparent, which makes it unlikely that they are in fact stored in the lexicon. Instead, allowing for an element of overlap between strata accounts for the phonological realisation as well as the semantics.

### 5.3 *Overlapping Modules*

The neuro-imaging data examined above demonstrates that the neural activity associated with language processing is not confined isolated areas. This suggests that if stratal models are in fact psychologically realistic, there must be areas of overlap between the modules of lexicon and syntax. It is notable that very early in the development of lexical stratification Kiparsky suggested the possibility that the '(l)owest level of phrase structure can in some way be fed back into the lexicon' (1982: 32).

Though the syntactic module is said to be unable to influence morphology, fMRI data from the neuro-imaging demonstrates that without recourse to the syntax, regularly inflected forms cannot be processed. This leads Marslen-Wilson and Tyler to conclude that 'inflectional morphology is ... exclusively syntactic in its function' (2007: 826). Although inflection plays a minimal role in English morphology, overlapping the modules of syntax and morphology is supported by a number of linguistic phenomena in derivational morphology. This argument is supported also by the existence of 'extremely productive phenomena traditionally regarded as being on the borderline between syntax and morphology', specifically the formation of several specific types of compounds (Carstairs-McCarthy 1992: 91). In the following sections, we will discuss compounds that appear to span the division between morphology and syntax.

#### 5.3.1 *Synthetic Compounds*

Synthetic compounds are exemplified here by the compounds *beer drinker* and *church goer*. At first glance, these compounds appear to be the result of the affixation of nominalising *-er* to a compound consisting of the two words, but this is not the case as, 'verbal compounding is not a productive process' in English (Booij 2007: 90). Instead, synthetic compounds are derived by the 'simultaneous use of compounding and derivation' (91). In each compound, the right-hand noun is derived from a verb, and the left-hand member 'serves as an argument of the verb' (Plag 2003: 149). This entails then that the 'interpretation of the compound is determined, to some extent, by the grammatical pattern available for the verb' (Bauer 2006: 494). Without recourse to the syntactic module, synthetic compound formation would not be possible.

### 5.3.2 Phrasal Compounds

The forms listed below in (13) and (14) exemplify “phrasal compounds”, a type of construction which provides evidence for the argument against the LIP:

(13) (a) Charles and Di syndrome

(b) Pipe and slipper husband

(14) (a) Open door policy

(b) Cold weather payment

(from Giegerich 2005b: 44)

There are a number of factors distinguishing compounds from (noun) phrases: phrases are fully productive, semantically transparent, typically end-stressed, and amenable to syntactic operations. For example, the modification of individual phrasal elements is allowed, as is what Giegerich refers to as the “pro-*one* construction”, in which the head of a construction is not filled by an ‘ordinary noun with inherent lexical content’ but is instead substituted with the ‘pro-form *one*’ (Stirling and Huddleston 2002: 1510–11, emphasis in original). Compounds on the other hand, are very much like other complex lexical items in that the patterns of compounding display varying productivity. While synthetic compounding is a very productive pattern, left-headed compounds and exocentric compounds are unproductive, fossilised patterns. In addition, compounds display a varying degree of semantic opacity and can carry either fore- or end-stress (Giegerich 2004; 2005b: 45–6). As compounds and phrases alike can be end-stressed, fully transparent or both, a key diagnostic in determining syntactic status is the construction’s ‘susceptibility to syntactic operations’ (2005b: 46).

The constructions in (13) and (14) above are not phrases, because they carry main stress on their first constituent. In addition, they are not available to the ‘pre-head modification patterns’, the modification of individual phrasal constituents, or the pro-*one* construction (Giegerich 2005b: 44, 46). Instead the constructions above are compound words that appear to contain ‘embedded constituents which ... strongly resemble phrase-level units’ (44). The No Phrase Constraint, which is arguably a more specific formulation of the LIP, states that ‘[m]orphologically complex words [including compounds] cannot be formed on the basis of syntactic phrases’ (Botha 1981, cited in Carstairs-McCarthy 1992: 99). In spite of this, however, “phrasal compounds” are not uncommon.

It must be noted however that it is possible to analyse the structure of these compounds in such a way that the LIP is maintained. As in Spencer’s analysis of ‘personal nouns’ (above, §4.2.3), the occurrence of phrase-level units inside compounds could easily be attributed to the fact that these units are “lexicalised”, and so are exceptionally stored in Stratum 1. This leads to Carstairs-McCarthy’s claim that the constructions in (14) specifically are ‘lexicalised or institutionalised phrases’ which allows them to

‘appear freely inside compounds’ (2005: 37). The problem with this, however, is that ‘lexicalisation is a phenomenon hard to pin down in formal grammar’ (Giegerich 2005b: 44).

While the appearance of phrasal compounds does not therefore instantly falsify the LIP, it certainly suggests that a compromise might be advantageous.

### 5.3.3 Associative Adjective Constructions

Associative adjectives are of particular interest because in many ways they fail to conform to the prototypical characteristics of an adjective. They form a subset of attributive-only adjectives, and never appear in either a predicative or postpositive position. In addition, they are not gradable nor can they be modified. In an associative adjective construction, the ‘property expressed by the adjective does not apply literally to the denotation of the head, but rather to some entity associated with it’ (Pullum and Huddleston 2002: 556).

There are three main types of associative adjective-noun constructions exemplified by (15) below:

- |                                 |                        |                          |
|---------------------------------|------------------------|--------------------------|
| (15) (a) <i>urban policeman</i> | (b) <i>papal visit</i> | (c) <i>musical clock</i> |
| <i>tropical fish</i>            | <i>papal murder</i>    | <i>electrical clock</i>  |

(from Giegerich 2005b: 47; 2005a: 477)

The semantics of the forms in (15b) display ‘argument-predicate relationships’, but the exact type of relationship can only be determined by ‘real-world expectations and encyclopedic knowledge’ (Giegerich 2009: 13). Similarly, the forms in (15c) can be interpreted by encyclopedic knowledge: a *musical clock* plays music, while an *electrical clock* runs on electricity. The forms in (15b, c) are associative adjective-noun constructions which are unquestionably lexical in origin. It is therefore unsurprising that these adjectives are only attributive, as the observation made ‘whereby associative adjectives cannot be heads of adjective phrases is merely part of the wider generalisation whereby associative adjectives are of lexical origin’ (2005a: 578).

Unlike the examples in (15b, c) however, the forms in (15a) are semantically transparent, and they have an attributive relationship to the head of the construction. In addition, they are the only ones that are amenable to the *pro-one* construction, such that — for some speakers at least — the sentence ‘*Is he a rural policeman or an urban one?*’ is ‘perfectly acceptable’ (2005b: 47). This diagnostic ‘unequivocally indicates phrasal status’ (48). In light of these facts, it appears as that despite the fact that all the forms in (15) are derived by the concatenation of an associative adjective and noun, some of them — those in (15b, c) — are formed in the lexicon, while others — like those in (15a) — are formed in the syntax.

As Giegerich points out however, there is a further complication. He notes that there are associative adjective-noun compounds, exemplified here by *dental appointment*, which is fore-stressed

(2005a: 587–8). Like the examples in (15a), the associative adjective *dental* has an attributive relationship with its head, and, more importantly is also amenable to the *pro-one* construction (2005a: 587–8; 2005b: 48). In other words, *dental appointment* has characteristics which are key diagnostics for both lexical and syntactic provenance. To reconcile the hybrid nature of the forms' phonological behaviour as well as their availability to the *pro-one* construction, Giegerich argues that given particular conditions, there are three possible types of associative adjective-noun compounds. While the majority of these constructions originate in the lexicon, some are unquestionably phrasal, and there are in fact some which fall into a third category, appearing to be simultaneously lexical and syntactic. The associative adjective-noun construction therefore straddles the boundary between lexicon and syntax, seriously undermining the Lexical Integrity Principle.

#### 5.4 Summary

In this chapter we have reviewed data from a number of neuro-imaging studies which conclusively proves that neural activity cannot be reconciled with a theoretical model in which the morphological component is completely dissociated from the syntactic module and vice versa. Although the neuro-linguistic data may at first have appeared to be conclusive evidence against the predictive accuracy of stratal models, it has become clear that lexical stratification, specifically Giegerich's base-driven approach, is not incompatible with the neuro-imaging evidence. Instead, the problem lies with the Lexical Integrity Principle. The weakening of the LIP — or its removal from the theory, as the case may be — is motivated on independent grounds. Neuro-imaging data aside, there are sufficient examples in the literature to indicate that the LIP incorrectly predicts the relationship between the modules of the grammar.

The issue of compounding is a controversial one, as it remains unclear if compound formation occurs in the lexicon or in the syntactic module (Bauer 2006, Giegerich 2004, Plag 2003). The discussion above seems to suggest that some compounding processes are simultaneously located in both modules. We have seen that the process of synthetic compounding benefits from a theoretical standpoint in which the syntax is allowed to influence morphological construction, albeit to very limited extent. In addition, the analysis of the so-called phrasal compounds suggests that along with influencing the semantics of compounds, 'phrase-level units' can in fact be fed back into the lexicon to form new compounds (Giegerich 2005b: 43). This process is productive, if highly context-dependent. Finally, the analysis of the associative adjective-noun constructions has demonstrated that there is a specific sub-set of this construction that is neither lexical nor syntactic in origin. Instead, the hybrid behaviour of the sub-set suggests that there is an area of overlap between the two modules. This in turn validates arguments against the absolute impermeability of the lexicon-syntax divide. Instead, contiguous strata, and indeed contiguous modules are comfortably allowed to interact.

In the final chapter, we will review the issues that have been raised thus far, and make some tentative suggestions regarding future research directions, in an attempt to answer the question that was asked at the very beginning of this paper. Given the current trends in research, is there still a place for lexical morphology?

# Chapter 6:

## Concluding Remarks

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### 6.0 *Introduction*

This chapter aims to provide a brief review of the issues that have been discussed in the previous five chapters, and some key aspects will be highlighted for further discussion. In addition, a tentative proposal will be outlined, with regards to a possible correspondence between lexical strata and the neural substrates that are associated with the processing and production of language.

### 6.1 *Review*

Chapter 1 charted the development of lexical stratification, beginning with the theory's origin in a series of papers by Chomsky that marked a movement away from transformational generative grammar. A number of competing stratal models were introduced, starting with Kiparsky's 'Lexical Phonology and Morphology'. In addition, aspects of these models that have come under criticism were highlighted and discussed. In the discussion of stratal models it emerged that Giegerich's base-driven stratal model is conceptually superior to other, affix-driven stratal models. As such, for the purposes of this paper, the base-driven model was adopted as the default stratal model.

The discussion in Chapter 2 was based on on the “new research direction” referred to in the introduction to Chapter 1 — that is, the cognitive-based approaches proposed by Bybee, Plag and Hay. The main focus of this chapter was on the very successful Complexity Based Ordering system proposed by Hay, as well as the interaction between Hay's model and the approach proposed by Plag. The argument against stratal models is based on what the authors see as the superfluity of the stratal apparatus, given that the cognitive-based approaches are predicated only on the morphophonological and syntactic behaviour of affixes.

In Chapter 3 the focus shifted to a discussion of theories which model cognitive language processing. The dual-route model of lexical access was found to be the most psychologically realistic, and indeed there is an compelling amount of neuro-imaging data which supports this particular model of lexical access. One key issue raised in this chapter was research by Vannest and Boland (1999) which shows that the dual-route model of lexical access is applicable within the framework of lexical stratification. This was the first indication that stratal models can in fact be maintained, even in light of the cognitive-based approaches to morphology.

Chapter 4 provided a comparison between the two theoretical approaches, with respect to two specific types of derivational constructions that were very early on were identified as being particularly

challenging for models of morphology. If Hay and Plag are correct, the weakness of stratal models would have been easily accounted for by their theoretical approaches. Instead, the discussion exposed several limitations of the cognitive-based models. As in Chapter 3, there are several theoretical aspects which highlight similarities between the cognitive-based approaches and the base-driven stratal model.

The discussion in Chapter 5 was an attempt to exploit the similarities that were identified in Chapters 3 and 4. Returning to the neuro-imaging studies that were briefly addressed in Chapter 3, it was suggested that the conclusions arising from brain imaging studies are in some ways compatible with lexical stratification models. While the argument against the lack of psychological reality in modular theories proved to be convincing, it was suggested that this can be overcome by adapting the model, such that the Lexical Integrity Principle no longer plays a vital role. It is important to note that this is not merely a stipulation, as the Principle has long been considered controversial. Instead, weakening, or indeed completely abandoning the LIP, is independently motivated. The neuro-imaging data provides additional justification.

## 6.2 Further Areas of Interest

At this point, we will return to the particularly interesting affix combination of *-ment* and *-al* (cf. §4.1.6). As we have seen, Plag's selectional restrictions alone cannot explain the behaviour of this combination. It was also demonstrated that the facts of *-ment-al* affixation indicate that Hay's cognitive-based Complexity Based Ordering theory and Giegerich's base-driven model actually capture the same generalisations. The frequency counts of *-al*, and Hay's subsequent suggestion that the complex forms *governmental*, *developmental* and *judgemental* are more likely to be stored whole in the lexicon could be seen as providing additional justification for Giegerich's argument that the same forms are located on Stratum 1.

Now we extend the discussion to Marslen-Wilson and Tyler's study of the neural substrates associated with morphological decomposition. The authors claim that there is compelling evidence from neuro-imaging data which suggests that 'all potentially derivationally complex words undergo an initial obligatory process of segmentation' (2007: 830; cf. §3.3.2 for a review of fully-decomposed models of lexical access). While this runs counter to the neuro-imaging data regarding the dual-route lexical access model, as well as the whole-word access of certain high frequency regular derivational complexes, if Marslen-Wilson and Tyler's claim is correct, Hay's analysis of *-ment-al* affixation is problematised. Without recourse to Giegerich's base-driven stratal model, there appears to be no satisfactory solution to the issue. It must be noted however, that this is a very tentative suggestion, as there is no way to conclusively prove this line of reasoning.

Marslen-Wilson and Tyler's (2006, 2007; Tyler and Marslen-Wilson 2009) arguments regarding cognitive modularity are particularly intriguing. Based on the neuro-imaging research carried out by the authors cited in §3.3.3 and §5.1.1 (Jaeger et al 1996, Beretta et al 2003, Vannest et al 2005), it is tempting

to tentatively propose — as Vannest and Boland seem to — that there is neuro-imaging data that appears to justify the theory of lexical stratification. Specifically, data from experiments about lexical access seems to suggest that the areas of the brain associated with the retrieval of listed irregular past tense forms corresponds with Stratum 1, which as we have seen, is the repository for monomorphemic forms, listed exceptions and Roots and affixes. In addition, Marslen-Wilson and Tyler report that the region in the brain which is activated when irregular forms are retrieved also shows signs of neural activity when regularly inflected past tense forms are accessed. Electroencephalography (EEG) and magnetoencephalography (MEG) studies show that the retrieval of regularly inflected forms is in fact associated with ‘three types of interdependent processing activities’, which includes the decomposition of the complex, retrieving the base and affix and interpreting the syntactic implications of the affix (Marslen-Wilson 2007: 180; Marslen-Wilson and Tyler 2007: 827). As we have seen in Chapter 5, evidence of overlapping areas of neural activation when processing complex forms is not incompatible with the base-driven stratal model. As such discussion so far does not appear to contradict the proposal being put forward here that there are specific neural substrates that correspond with the stratal apparatus.

So far, it has been suggested that Stratum 1 corresponds with the neural substrates associated with the processing of monomorphemic and listed irregular forms. At this point, perhaps it possible to extend this proposal further, such that Stratum 2 can be seen as corresponding with regular morphological processes, including regular inflectional morphology and transparent patterns of derivation. Indeed, Marslen-Wilson reports that Clahsen et al (2003) suggest that ‘[i]rregular inflected items and opaque derived forms’ are grouped together — perhaps, as suggested above, in a region of brain corresponding with Stratum 1 — while regular inflection and transparent derivational processes are similarly ‘grouped together’ (Marslen-Wilson 2007: 188). However, Clahsen et al go on to argue that there is actually a three-way distinction between the morphological processes, as derivational morphology shares characteristics with listed forms as well. While the three-way distinction does not correspond ideally with the two-stratum model, it is possible that the shared characteristics identified here are effectively responsible for the overlapping phonological behaviour displayed by Stratum 1 and Stratum 2 forms (cf. §5.2). In addition, it is possible that this area of overlap corresponds with the Root-to-Word transition (cf. §1.2.5). Either way, it appears as though the suggestion put forward here — that lexical strata do in fact correspond closely with neural substrates associated with language processing — cannot be conclusively disproved.

A recurring problem identified in this discussion is the lack of neuro-imaging studies concerning derivational morphology. As Marslen-Wilson notes, a substantial amount of research has been ‘directed at a single morphological sub-process (the English past tense), addressing its properties in a multidisciplinary manner from computational, linguistic, behavioural and neural perspectives’ (2007: 176, brackets WM-W). This exhaustive research comes at the price of neglecting other morphological processes, and it is hoped that the lack of neuro-imaging studies on derivational morphology will be addressed in the future.



### 6.3 *Final Remarks*

It is hoped that in the course of this paper the arguments levelled against the stratal model, including the lack of psychological realism and the superfluity of the stratal apparatus, have been comprehensively addressed. Even if the arguments of Bybee, Baayen, Hay and Plag have not been empirically refuted, the possibility of a compromise between the two theoretical approaches has been suggested as a promising area for future neuro-cognitive research. Without detailed neuro-cognitive and neuro-imaging studies regarding derivational processes, the possibility of a compromise between the two models cannot be disproved — or, unfortunately, proved. Without more research directed at this area of morphology, it will not be possible to definitively ascertain how derivational processes are organised in the brain, with respect to inflectional morphology and listed forms.

Now that we have arrived at the end of the discussion, it seems fitting to return to the very beginning of this paper. We have seen that the theory of lexicalism was developed as a result of remarks (in fact, ‘Remarks’) made by Chomsky, and so returning to Chomsky’s remarks allows us to argue for a potential connection between lexical stratification and the cognitive-based approaches. Myers notes that in *Aspects*, Chomsky states that ‘linguistic theory is mentalistic, since it is concerned with discovering a mental reality underlying actual behavior’ (Chomsky 1965: 4, quoted in Myers 2007: 107). To Myers, this cuts straight to the ‘core of the competence-performance distinction’, the study of which is the goal of cognitive psycholinguistics. To Myers, therefore, there is much that cognitive linguists and linguistics working in the formal framework can learn from each other, as ‘[t]he two disciplines do not work on qualitatively different issues or in qualitatively different ways’ (123). It is hoped that Myers’ belief in the very real possibility of a synthesis between the two theoretical approaches is reflected in this paper.

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